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Turboprop Hopes—

PROPITIOUS this week is the horoscope of the turboprop. Ascending fortune is foretold in every field of current application. Rich new markets are at hand, and acceptance is at last assured for aircraft of the smaller sizes. What, now, are the portents for Britain, where the turboprop was first airborne and where output to date still rates as "most" and quality as "best"? Commercially, the formation of the Bristol Aeroplane Co. (U.S.A.) Inc. is but one bright sign of the times—an earnest of Britannia plans and an act of faith in the turboprop. That same faith was verbally affirmed by Mr. Peter Masefield, Bristol Aircraft managing director, in his R.Ae.S. main lecture (pages 447-448). In speed, he forecast, the turboprop was "not going to be all that far behind the jets"; and his citation of good range performance, low noise level, simple air-traffic control and cheapness—which he set against speed and simplicity for the jet—would be difficult to refute.

The immediate fortunes of Bristol's turboprop venture are clearly dependent on the Proteus. Above all, this is a reliable engine—to the extent that B.O.A.C. are able to schedule Britannias on two round trips to Johannesburg, or one to Sydney, without opening the cowlings. The now-familiar appraisal of the Proteus —"a sort of big Dart"—is the accolade.

If the Protean scene is satisfactory, then Britain's future hopes may well be sanguine, for not only are Bristol in the field with their "supercharged" Orion, but Napier are there with the Eland and, of course, Rolls-Royce with the Tyne. Neither in the U.S.A., where Allison and Pratt and Whitney are increasingly exerting themselves, nor in Russia, where commercial competition is already emerging, are equally good civil powerplants likely to appear on the same time-scale.

—and Fears

So far, so good. What, now, of our shortcomings? One is clear from Mr. Masefield's reminder that Russia's long-range bomber, the Bear, cruises on turboprop power at 510 m.p.h. (though he, as ourselves, would like to know the noise-level of the propellers). This means that in the higher speed-bracket the Russians are accumulating experience at present denied to us in Britain, though this background we shall certainly require if we pursue such projects as the Bristol 187. In development on these lines America, too, is ahead, having, in the Republic XF-84H, a test-bed for supersonic turbine-driven propellers absorbing some 6,000 h.p. An ambitious ground-running programme is also in hand.

We may well discover, however, that it is at the diminutive end of the turboprop range that our deficiencies are most apparent. The thought is prompted by a description, in this same issue, of the Douglas Model 1940, with four Lycoming T55 turboprops. This 1,500 s.h.p. T55 is but one of several small, efficient, foreign units now under development for numerous, and extremely promising, applications. It has a stablemate in the T53 (about 800 s.h.p.) and a keen rival in General Electric's T58, a unit which may eventually be licence-built outside America. Already there is talk of a Handley Page Herald with four of these little engines. France, in her turn, will be putting forward an assortment of Turbomécas, ranging in shaft horse-power from 200 to over 1,000, for which Blackburn and General Aircraft are licencees.

The sole British offering (the early Halford H.3 having been abandoned) is Napier's Gazelle, a unit for which the Bristol and Westland helicopter installations now scheduled may well be followed by others in the fixed-wing, as in the rotary-wing, field. But so broad and bright are the prospects for the small turboprop—in feederliners, VTOLs, STOLs, helicopters, tourers, reconnaissance and liaison aircraft—that we must keep a sharp eye on developments abroad and constantly review our programme in the light of what we see in America, France and Russia.

FROM ALL QUARTERS

The New Chiefs of Staff Chairman

NOMINATED by President Eisenhower on March 26 to succeed Admiral Radford as chairman of the Joint Chiefs of Staff, General Nathan Twining becomes the first U.S.A.F. officer to occupy this position. During the war he commanded the 13th Air Force, which operated in the Pacific; and he has long been an advocate of the view that the Air Force must decide any big future war.

His appointment to the Chiefs of Staff chairmanship—which takes effect on August 15—means that the two highest Western military posts (the other being the NATO supreme command held by Gen. Lauris Norstad) are both held by Air Force officers.

Bristol to Form U.S.A. Subsidiary

A NEW company, to be known as the Bristol Aeroplane Company (U.S.A.), Inc., is to be formed in New York as a subsidiary of the Bristol Aeroplane Company. Its principal activity will be the co-ordination of sales and allied matters for the Bristol Group companies.

The chairman will be A. Cdre. F. R. Banks, a director of the parent company, and initially the president and chief executive will be Mr. Stanley Haggett, who is vice-president of Bristol Aircraft (Western), Ltd., in Canada, and was formerly general manager of the company's Winnipeg factory. Later in the year Mr. Haggett will be succeeded by Mr. David E. Proudlove, who is being released from his present appointment as British Civil Air Attaché, Washington, in order to join Bristol.

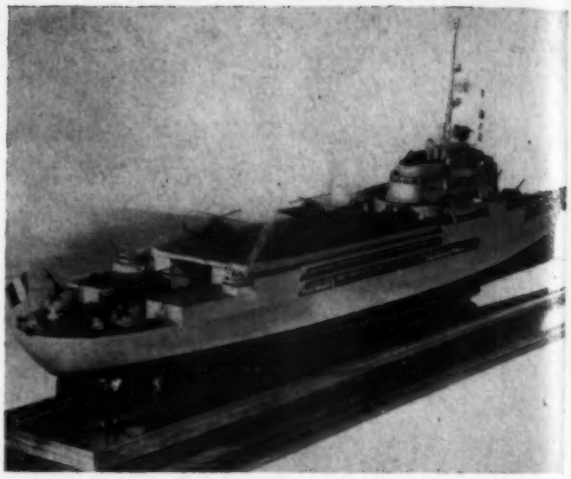
S.6B for L.A.P.

SOUTHAMPTON Borough Council has agreed to lend the Ministry of Transport and Civil Aviation a Supermarine S.6B racing seaplane (Rolls-Royce R engine) for exhibition at London Airport. The machine was presented to Southampton by Supermarine in 1937, and originated, in 1929, as an S.6. It was flown in the 1929 Schneider Trophy Race by F/O. (now Air Marshal Sir Richard) Atcherley, who, although disqualified for missing a turning point, completed the course and, incidentally, set up world records over the 50-km and 100-km distances at 332.49 and 331.75 m.p.h. Reconditioned and modified as an S.6B, the same aircraft was the British team's number three in the final contest in 1931; and it appeared in the film *The First of the Few*, starring Leslie Howard as R. J. Mitchell.

U.S. Navy Flying Boats

PROPOSALS for a flying-boat of exceedingly advanced design capable of being employed as an integral member of air, surface and underwater anti-submarine teams for the U.S. Navy recently led to a design competition to which tenders were submitted by Grumman, Martin and Convair. The last-named concern has now emerged as winner of the competition. It is expected that the resulting flying-boat will have very great range and endurance and will be able to operate in almost any sea state.

Martin's production of the P6M SeaMaster has been stretched out to allow a completely new design of empennage to be incorporated (faults in the tail, and the tailplane-actuating mechanism in particular, caused the loss of the first two prototypes). At present, Martin are to build six YP6M-1 aircraft powered by afterburning Allison J71 turbojets. The first pre-production machine was to have flown before May but is now unlikely to take the air until September. Martin also hold a £36.5m contract for the manufacture of 24 production P6M-2s powered by the larger Pratt and Whitney J75 engine.



HELICARRIER: In peace-time this striking craft will be a training ship for French cadets. In war-time she would serve as a helicopter-carrier for the French Navy. A 10,000-tonner, designed for a speed of 26.25 kt, she would carry twelve "heavy helicopters." Other details were given in "Flight" of March 22 (p. 361).

Braking Bobbin

LAST week we published details and illustrations of Bristol's Bobbin supersonic test vehicle for research into ramjet-propelled anti-aircraft missiles. One of the photographs showed a Bobbin after recovery by parachute; and the Irvin Air Chute Company of Great Britain, Ltd., announce that they were the suppliers of the parachute system employed.

The system used consists of a small extractor parachute deploying a cluster of six ribbon parachutes while the missile is travelling at supersonic speed. After a delay controlled by a sequence switch the main canopy is deployed with its lines reefed. Then, after a further prescribed interval the reef tie is cut by Irvin twin electrically operated cutters designed for this purpose, allowing the main canopy to develop fully.

East African Surveys

SOME 38,000 square miles of East Africa—partly in Tanganyika, partly in Bechuanaland—will be surveyed from the air for the first time under a contract recently awarded by the Directorate of Colonial Surveys to Fairey Air Surveys, Ltd.

These East African surveys form part of the British Government's colonial development scheme. They are due to start in mid-April and should be complete by the end of July. For both operations a Douglas DC-3 with highly supercharged engines, allowing it to operate at heights up to 28,000ft, will be employed, though the surveys will be carried out at 20,000ft.

In Bechuanaland, with the aircraft operating from Bulawayo, Southern Rhodesia, 18,000 square miles will be photographed and

FISH OUT OF WATER: The Marlin flying-boat below is docked in a U.S. Navy L.S.D. (landing ship dock) in Chesapeake Bay. In a recent announcement the makers (Martin) claim this technique to be new, but we believe they will be edified by the "Flight" photograph also reproduced. This dates from 1934, and shows a Short Singapore III of No. 210 Squadron, R.A.F., under similar circumstances. The R.A.F. dock was able to accept two Singapores simultaneously. It would be interesting to know the fate of this curious craft.

FIRST FLIGHT of the Canadair CL-28 Argus was made on March 28—three days ahead of schedule. This anti-submarine development of the Bristol Britannia was airborne for 75 min. At the controls was the chief test pilot, William Longhurst.

mapped as part of a general plan to open up the territory. The survey will also provide information for geological research and for investigations leading to more intensive cattle-rearing.

The Tanganyika survey, based on Arusha, will operate in the Moshi-Arusha area, to the south-west of Mt. Kilimanjaro. Though the main emphasis is again on general development, the aerial photographs will also assist in identifying tracts of scrub and woodland which support the tsetse-fly.

Napier-Aerojet Rocket Agreement

LAST week-end D. Napier and Son Ltd., announced "an exchange of technical knowledge on liquid-fuel rocket engines—primarily those using high-test peroxide" now operating between themselves and the Aerojet-General Division of the General Tire and Rubber Company. Aerojet have long been one of the largest American rocket firms, and have very great experience with motors for take-off boost, high-altitude research vehicles and all types of missiles. Napier, also, have over seven years' intensive rocket experience.

Training Commercial Pilots

A FAR-SIGHTED scheme to provide standard commercial pilot's training at flying clubs, and to establish a scholarship fund to assist those taking the course, received a warm welcome when launched at an Association of British Aero Clubs and Centres meeting last Monday.

Introducing it, the A.B.A.C. chairman, G/C. G. H. M. Miles, said the syllabus had M.T.C.A. approval; that as the course involved a minimum of 150 instead of 200 hours' flying and would shortly be available at a dozen clubs, pilots could train more quickly and nearer home; and that he had received a gift of £500 for the fund from Kuwait's president of aviation.

Both Corporation and independent airline representatives present were quick to show approval of the scheme; and further promises of financial support brought the fund to £1,000 by the end of the meeting.

FLYING AIDS REVIEWED

NEXT week's issue of "Flight," dated April 12, will be an enlarged special number having as its theme modern flying aids and systems. This is the first time we have devoted a special issue to such a subject; and never before, to our knowledge, has any journal presented such a comprehensive review as that which will form the main feature of this number. Scores of types of equipment—in service and projected—will be reviewed and illustrated, and their applications and operation explained. The extensive field is dealt with in appropriate sections, so that the issue will form a particularly valuable work of reference. In addition, regular "Flight" features will be retained.

Lennox-Boyd Trophy Pilots

THIS year's winner of the Lennox-Boyd Trophy (instituted by the present Colonial Secretary when Minister of Transport and Civil Aviation and awarded annually to a flying club on an efficiency basis) is the Fair Oaks Aero Club, near Woking, Surrey. Its chief flying instructor, W/C. C. E. F. Arthur, will receive the trophy for 1956 at the Association of British Aero Clubs and Centres annual dinner this evening, April 5.

AUSTRALIA AND THE F-104: Mr. F. M. Osborne, Australian Minister for Air (second from left), congratulates Lockheed test pilot Ray Crandall after a flight in an F-104B. (An R.A.A.F. order is reported on page 431.) At left is "Fish" Salmon, chief engineering test pilot. In uniform is G/C. Peter Parker, Australian Air Attaché to the U.S.A. and Tony LeVier, director of flight operations, completes the group.

NEW ZEALAND AND THE AGRICOLA: Already at work with Rangitikei Air Services is the second Auster Agricola. While the pilot does his cockpit check a lorry is seen moving in to dump superphosphate in the hopper. The engine is kept running and the turn-round time is no more than 30 sec. A mirror at the top of the port oleo allows the pilot to see in flight when phosphate delivery has ceased.

DOUGLAS 1940

Santa Monica's Own DC-3 Replacement

"Flight" copyright drawing

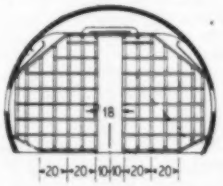
DURING the past decade the game of designing an aeroplane to replace the ubiquitous DC-3 has been played in a dozen countries without any conclusive results. Now Douglas Aircraft have themselves written down a specification for what they feel ought to be done and have issued it to prospective customers to see what reception is accorded. Aircraft of this general type have been bandied about at Santa Monica for years, but it is only within the last few months that the Model 1940 has become firm.

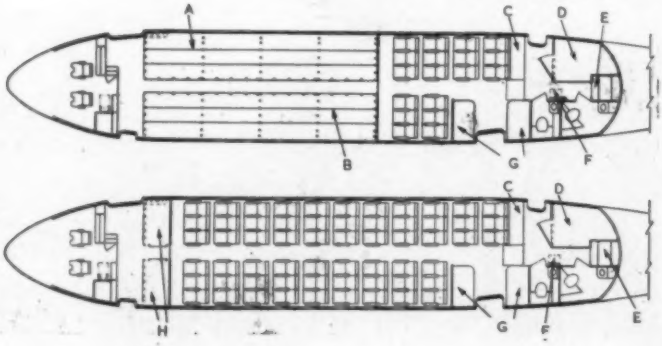
Diagrams below indicate floor plans and a cross section of the usable portion of fuselage. The interior width at floor level is 132in, sufficient to allow triple seat units to be installed on both sides of an 18in central aisle. When seats are installed at the 40in pitch corresponding to the window spacing a total of 60 passengers can be accommodated, together with a forward freight compartment of 164 cu ft, an aft freight compartment of 143 cu ft and carry-on baggage bays totalling 135 cu ft flanking the main passenger door.

From the flight deck to station 520 (roughly amidships) the floor is stressed to support cargo at 200 lb/sq ft at a maximum longitudinal distribution of 100 lb/in. The seats in this region can be folded and removed so that, when the floor is cleared back to station 520, 18 passengers can be accommodated (with the carry-on baggage and rear cargo compartments) together with 15,000 lb of cargo in the 1,557 cu ft space ahead of the movable bulkhead. Cargo is loaded through a door 60in high and either 48 or 75in wide (according to customer preference) on the starboard side immediately behind the flight deck.

Douglas have chosen to pressurize the cabin even though the routes for which the 1940 is designed would restrict the aircraft to essentially low-altitude operation. A maximum operating differential of 4.16 lb/sq in has been chosen, to increase the flexibility of operation and to provide a more comfortable ride for passengers; it is also, of course, a great help to maintain sea-level pressure during rapid climbs and descents and when air is turbulent at low altitudes. Cabin air is drawn from engine-driven compressors and is then cooled by a heat exchanger (backed up by a Freon evaporater) or heated by electric resistances.

All the illustrations on this page refer to the basic Douglas Model 1940. The cross-section (right) indicates widths in inches. Key to the floor plans: A, tie-downs at 2in spacing; B, freight floor; C, buffet; D, 143 cu ft cargo; E, coats; F, tip-up seat; G, carry-on baggage; H, 164 cu ft cargo in passenger version.





Douglas have also planned a Model 1940A civil/military utility transport with an unpressurized fuselage and floor 220in long and 116in wide, stressed to take freight at 300 lb/sq ft. The 1940A has an upswept rear fuselage with rear doors 98in high by 100in wide admitting a 12-deg ramp at a typical truck-bed height of 50in above ground level. It is at present envisaged that the A-model will have a "universal" undercarriage with attachments for skis through which the wheels will project for hard-surface operations. Data for this special type follow those for the basic Model 1940.

During its early life the 1940 project featured all kinds of high-lift devices, including a variable-incidence wing and/or blown flaps or boundary-layer control. In the finalized design the wing is quite straightforward, though it has been fitted with a very effective flap system for operation at lift coefficients which must approximate to 3. Double-slotted flaps of no less than 40-per-cent chord extend from root to tip on each mainplane, and leading-edge flaps of 15-per-cent chord are employed to improve the flow at high angles of attack. The full-span flaps do not double as ailerons; control in the rolling plane is effected by slot-lip spoiler segments actuated by hydraulic rams. The rudder and elevators are manually operated via spring tabs.

Douglas have a high regard for the Rolls-Royce Dart 510 in view of the British engine's proven reliability and effectiveness as a commercial transport powerplant. Four Dart 510s would fit the 1940 admirably, and should eliminate any chance of the programme being held up through powerplant unavailability.

Standard powerplant for the new Douglas is, however, the

(*Concluded at foot of page 432*)

DOUGLAS 1940

(Four 1,500 s.h.p. Lycoming LTC4A-1 turbines)

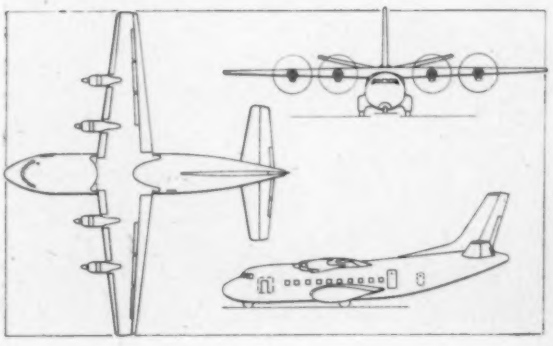
Dimensions: span, 102ft 6in; length, 92ft 6in; height, to fin-tip on ground at maximum weight, 36ft 8in; gross wing area, 1,300 sq ft; tailplane span, 42ft 8in; track, 12ft 2in; wheelbase, 29ft 10in; body cross-section, 152in wide by 144in high

Weights: empty (typical), 39,350 lb; basic operating, 40,815 lb; capacity payload, 15,000 lb; capacity fuel, 26,000 lb; maximum gross, 65,500 lb; maximum landing, 65,000 lb; zero-fuel, 56,000 lb.

Performance: maximum weight take-off field length, s.l., standard day, 20-deg flap, 2,330ft; landing at 65,000 lb, 50-deg flap, 3,000ft; landing at 59,600 lb, 2,770ft; range with maximum payload, 560 n.m.; range with 10,000 lb payload, 1,075 n.m.; typical cruising speed, 261 kt; performance on 300 n.m. stage: take-off at 63,100 lb with maximum payload, field length, 2,121ft; block time 1 hr 22 min, A.T.A. cost 1.4 cents/200-lb n.m.; performance on 80 n.m. stage: as above, except, block speed 153 kt, fuel consumed 1,269 lb in 31 min (10 min for taxying, take-off and landing), leaving 5,710 lb reserve. A.T.A. cost 2 cents/200-lb n.m.; D.O.C. falls from $2.1 per aircraft n.m. on 50 n.m. stage through $1.15 at 200 miles to $1 at 600 miles.

Model 1940A

Generally as above, except: maximum payload, 16,000 lb; maximum landing weight, 59,100 lb; range, 1,590 n.m. cruising at 243 kt.



HERE AND THERE

ALL THE WINNERS: After the R.Ae.C. general meeting on March 27, Lord Brabazon presented the Club's annual awards. Top, l. to r.: Lord Brabazon with Peter Twiss (Britannia Trophy and Geoffrey de Havilland Trophy); M. Paul Morain (Bréguet Trophy); model-aircraft champion Ray Gibbs (bronze medal). Lower, l. to r.: "Brab" and gliding silver medallists Tony Goodhart, Frank Foster, and Nick Goodhart. Details of the awards were given on pp. 128-9 of "Flight" for February 1.

Exports Up Again

BRITISH aviation exports during the first two months of this year totalled £16,742,595, exceeding the January-February total last year—itself a record amount—by more than £1,500,000.

M.o.S. Britannia Orders

IN the House of Commons on March 28 the Minister of Supply, Mr. Aubrey Jones, said that in addition to one Bristol Britannia 100 and one Britannia 300 which had been delivered to his department for development work, the M.o.S. had orders outstanding for 13 Britannia 253s for Transport Command and three Britannia 252s intended for trooping.

Delivered to User

TWO supersonic "Century" aircraft are about to enter service with the U.S. Air Force. The McDonnell RF-101 strategic reconnaissance machine will equip the first of two squadrons of the 363rd Tac Recon Wing at Shaw A.F.B., South Carolina, late this month. They will probably replace the Wing's Republic RF-84F aircraft and not the Martin RB-57s. Late in May Lockheed will start delivering the first F-104A Starfighter day fighters to Hamilton A.F.B., Cal. They will be the first of their type to enter squadron service. A total of 30 Starfighters, possibly including a small number of two-seat F-104Bs, has been ordered by the Royal Australian Air Force for delivery in a little more than a year's time. Other news of U.S. military aircraft appears on p. 446.

Squires Gate Tenancy

NO alternative use for the Hawker Aircraft factory at Blackpool has yet been found, the Minister of Supply, Mr. Aubrey Jones, stated in a written Parliamentary answer on March 27. He added that with the company's agreement he had asked the President of the Board of Trade to seek another tenant on the termination of the Hawker Aircraft Company's current programme.

Two Cities' Record

A RECORD time of 5 hr 24 min 26 sec for a flight from Los Angeles to New York was achieved recently in a Douglas A3D-1 Skywarrior piloted by Cdr. Dale Cox with a U.S. Navy crew. The aircraft flew from Los Angeles to New York and back and although it did not set up a new record on the return journey it lowered the figure for the combined trip by 1 hr 42 min 39 sec, with a time of 11 hr 18 min 27 sec. The Skywarrior's time for the 2,500-mile Los Angeles-New York flight was 9 min 28 sec better than the previous best, in 1955.

EVALUATION: To assess the possibility of its meeting their requirement for a light two-seater helicopter, the U.S. Army has been evaluating the Fairey Ultra-Light. During the discussions its manufacturers have been represented by the Piasecki Aircraft Corporation of Philadelphia. Fairey Aviation are also intending to undertake a commercial sales programme for the aircraft. In this new picture the Ultra-Light appears with two additional fins.

Photographers' Show

NEXT week's (April 10) issue of *Amateur Photographer* will be a special number devoted to the British Photo Fair at Olympia (April 11-17), in the activities of which our associated journal will be taking a prominent part.

Quarter Century

ON March 25 Mr. Max Conrad, of California, completed his 25th Atlantic crossing in a light aircraft when he landed at Shannon in a Piper Apache after flying solo from Gander, Newfoundland, in 12 hours 50 minutes.

Eland-Electra?

ACCORDING to *American Aviation Daily* Lockheed aircraft are no longer considering the Rolls-Royce Tyne as an alternative to the Allison 501 in the Lockheed Electra. It is predicted that the American manufacturer will substitute a late-model Napier Eland.

Vampires for Austria

THREE de Havilland Vampire trainers, the first to be fitted with both Marconi A.D.F. and I.L.S. equipment, were on March 27 delivered to the Austrian Air Force. Austrian pilots had previously taken a short conversion course at the de Havilland Servicing School.

Nationalist Helicopter

A REPORT from Formosa says that the first helicopter built by Nationalist China—described as a "flying banana type designed by Maj-Gen. Chu Cmia-Jen, a Chinese Air Force aeronautics specialist"—has made a successful test flight.

Discussing Plastics Progress

TWENTY-TWO authorities on plastics will speak at the convention to be held in conjunction with this year's international British Plastics Exhibition at Olympia, London, July 10-20. Subjects will include new extrusion and injection moulding techniques, and recent developments in polythenes, polyvinylchloride and foamed plastic materials. Tickets for the convention may be obtained from the organizers, British Plastics, Dorset House, Stamford Street, London, S.E.1, England.

The Sherpa at Cranfield

Continuing Work on the Aero-Isoclinic Wing

By F/L. A. J. McDONALD*

The extreme positions of the Sherpa's elevons in this photograph indicate low-speed flight and high angle of attack.

THE Short Sherpa once again takes the air on a series of experimental flights for the College of Aeronautics. It may be remembered that this aircraft made its first flight on October 4, 1953, since when it has flown at the Farnborough Air Display and subsequently, having finished its flight trials, was handed to the College for further experiments and thesis work.

The Sherpa was originally built to combat torsional instability and tip-stalling characteristics of conventional swept wings, with the associated tendency to aileron reversal.

A characteristic of swept-back wings is that they bend upwards under air loads and consequently lose incidence at the tips. This condition is mainly found when pulling out of dives: the loss of incidence at the tips acts like an upward deflection of the elevator, and the aircraft pulls out more sharply than was intended. In the R.A.F. this effect is known as "pitch up" and on high-speed aircraft can give rise to a form of dynamic instability which is sometimes fatal.

The wing designed for the Sherpa was aero-isoclinic, with a 42 deg sweep. The term "aero-isoclinic" describes a wing having an angle of incidence that remains constant regardless of flexure. This is achieved by placing a torsion box well back in the wing, so that the air loads, acting in the region of the quarter-chord line, have a considerable moment arm about it. This condition is not easily achieved in an ordinary wing, where the torsional stiffness is dictated by considerations of aileron reversal; but the Sherpa has all-moving wing-tip controllers which, known as elevons, act as the ailerons and elevators. Being well to the rear of the wing, these controllers make it possible to dispense with the tailplane, thus saving weight and drag. They also prevent the tendency to tip stalling at low speeds, due to the fact that the wing-tip incidence is reduced on a backward movement of the control columns.

Mr. M. C. Wilson, A.F.C., B.Sc., D.C.Ae., A.F.R.Ae.S., supervising the research programme, says:—

"Trailing-edge ailerons have been in vogue now for several decades, but it seems probable that their days are numbered. Present-day fighter aircraft, although having a phenomenal rate of roll at high speeds, tend to suffer from poor initial response; and at the other end of the scale, certain high-aspect-ratio swept-wing bombers have been trying out spoiler-type lateral controls.

"In both these fields the Sherpa type of all-moving tip appears to score heavily. It appears that the initial response is excellent, and the design ensures that twisting effects on a high aspect-ratio wing are kept to a minimum. This should permit an all-round weight saving, due to the relaxation of wing-stiffness requirements.

"The rolling performance of the Sherpa is being investigated by one of the second-year students at the College of Aeronautics for his experimental thesis. A detailed analysis will be made from the results and comparisons made with more conventional aircraft. The standards of instrumentation for this type of test are very high; but with the equipment available at the College no difficulties are anticipated, and we look forward to some interesting findings.

"This investigation into lateral response is the first step in what is hoped will be a long series of tests of a basic nature. The second stage, which is being considered at the moment, may consist of new methods of flight flutter-testing, followed in all probability by studies of the dynamic longitudinal stability. Without doubt, the Sherpa is an ideal research vehicle for second-year experimental thesis work at the College of Aeronautics."

The Sherpa is a very pleasant aircraft to fly in fine weather and has ample control at low speeds (i.e., just above the stall) but tends to become a bit of a handful in bumpy conditions. The test flight envelope is between 70 and 130 knots, with a maximum g of 2½. It is hoped that this envelope will be extended as the test flight results are investigated.

The power units are two Blackburn Turboméca Palas which, although sufficient for the work, call for rather judicious handling.

This aircraft is not capable of high speeds; but the lessons learned from the tests should form a basis of design for future high-speed civil and military aircraft.

* *Test pilot, College of Aeronautics, Cranfield.*

DOUGLAS 1940 (continued from page 430)

Lycoming LTC4A-1 (T55), a scaled-up version of the T53 described in *Flight* for April 27, 1956. The new engine, which is described and illustrated at the foot of this page, is light, compact and of free-turbine configuration, with an automatic fuel control. It will be installed as a powerplant, removable through clam-shell doors in the underside of each semi-monocoque nacelle. Three-bladed, high-solidity propellers will be used, with a diameter of 13ft and a minimum clearance of 38in from the fuselage and 78in from the ground. Blades, spinners and engine intakes will be de-iced electrically.

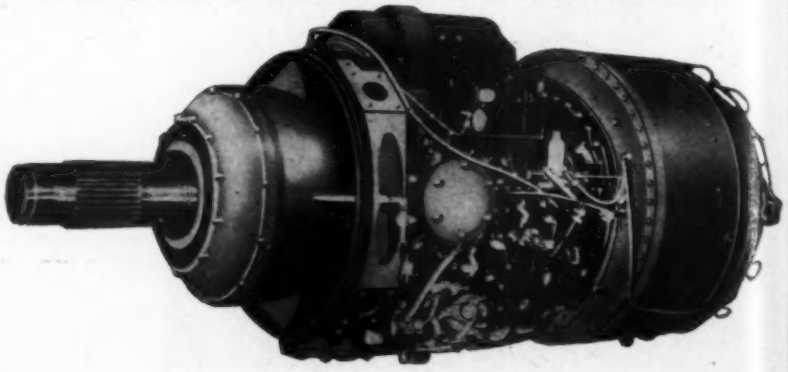
Integral wing tanks will house a total of 4,000 U.S. gal (3,331 Imp. gal). All fuel will be taken aboard through a single pressure-fuelling socket, with a flow rate of 400 U.S. gal/min, near the front of the starboard undercarriage fairing. Everything possible is being done to allow the aircraft to achieve new standards of high availability and quick turn-round.

At present Douglas have no firm plans to go ahead with the 1940, but it has completed the engineering project stage and is ready for detail design and tunnel testing. Should the market appear sufficiently favourable Douglas would probably sell the aircraft as the DC-10. No price has yet been quoted but it is understood that certificated production aeroplanes could be made available three years from now, at an overall cost (assuming bulk orders) of rather more than $1m, i.e. about £400,000.

1,500 s.h.p. LYCOMING

POWERPLANT of the new Douglas transport, the T55 free-turbine engine is the second gas turbine for aircraft propulsion to be designed by a team under Dr. Anselm Franz for the Lycoming Division of Avco, of Stratford, Connecticut. It comprises an axial/centrifugal compressor, a reverse-flow annular combustion chamber and mechanically independent compressor and power turbines. Data below refer to the fixed-wing version, the commercial version of which (LTC4A) powers the Douglas 1940. The rotary-wing version is rather more powerful and, having a simpler gearbox, weighs but 600 lb.

In external appearance the Lycoming LTC4A-1 (T55) strongly resembles its smaller predecessor, the T53. The latter was described in our issue of April 27 last year.



Dimensions and weight: overall length, 58.8in; nominal diameter, 24.25in; dry weight with basic equipment, 665 lb.

Performance: maximum rating for take-off, 1,500 s.h.p. (1,651 e.h.p.) at 1,200 r.p.m. on the output shaft; corresponding s.f.c., 0.657 lb/hr/e.h.p.; maximum continuous rating, 1,383 e.h.p. with s.f.c. of 0.680.

Appropriately painted battleship-grey, XJ 474, the first fully developed Sea Vixen, has its compass swung at Christchurch.

PROGRESS WITH THE SEA VIXEN

The Navy's Latest All-weather Fighter in Development at Christchurch

WITH no exact counterpart, either existing or projected, in any foreign country, the de Havilland 110 Sea Vixen has been adopted by the Royal Navy as the most advanced and powerful British carrier-based all weather fighter. It fits perfectly into the whole picture of our naval defence and promises to be able to accomplish its manifold tasks extremely well.

At the outset it is essential to clarify a factor fundamental to proper understanding of the design. Although the Sea Vixen of 1957 bears a close superficial resemblance to the original D.H.110 prototype, the two aircraft have scarcely a single part in common. In fact, even the superficial resemblance is no small tribute to the soundness of the basic conception in view of the fundamental change in rôle during the life of the design.

An account of the genesis of the de Havilland 110 was published in our issue of January 21, 1955. Almost two years earlier the Admiralty had began to consider the aircraft as a possible replacement for the de Havilland Sea Venom, the Royal Navy's first jet all-weather fighter which began to go into service in 1952. At that time the Sea Venom was one of the most advanced aeroplanes that could effectively be operated from existing carriers. Only by virtue of the joint British inventions of the angled deck and the steam catapult has the standard size of Fleet carrier been transformed into a vastly more effective ship capable of handling much heavier and faster aircraft (as was explained in our issue of March 22).

This increase in carrier ability opened the way to the purchase of aeroplanes of the calibre of the de Havilland Sea Vixen. A production contract for a substantial number of these aircraft was signed at the beginning of 1955.

The Christchurch factory's interest in the Sea Vixen started in 1953. Throughout the following year work went ahead both at Hatfield and at Christchurch on completely re-designing the aircraft for its new rôle as a carrier-based fighter, while to the Hatfield-built prototype WG 240 was assigned a vital series of trials.

As originally built, this aeroplane was equipped with flying controls of a character frequently to be seen in British jet aircraft after World War 2. The variable-incidence tailplane was worked by electric screw-jacks and was used only for trimming. The basic control system comprised hydraulically boosted elevators with feed-back and manual reversion, fully powered ailerons without feed-back but with emergency manual reversion, and manual rudders. It was soon apparent that, owing to the unsuitability of the tailplane as a control surface and the inadequate transonic effectiveness of the elevators, the tailplane/elevator combination was inadequate for the full manœuvre potentialities of the aircraft to be realized. Moreover, the fixed "gear ratio" in the feed-back linkages made it impossible to achieve properly matched control characteristics at both ends of the exceptionally great speed range; and, by the same token, the high control forces required at the transonic end of the speed range made manual reversion of little value in that regime.

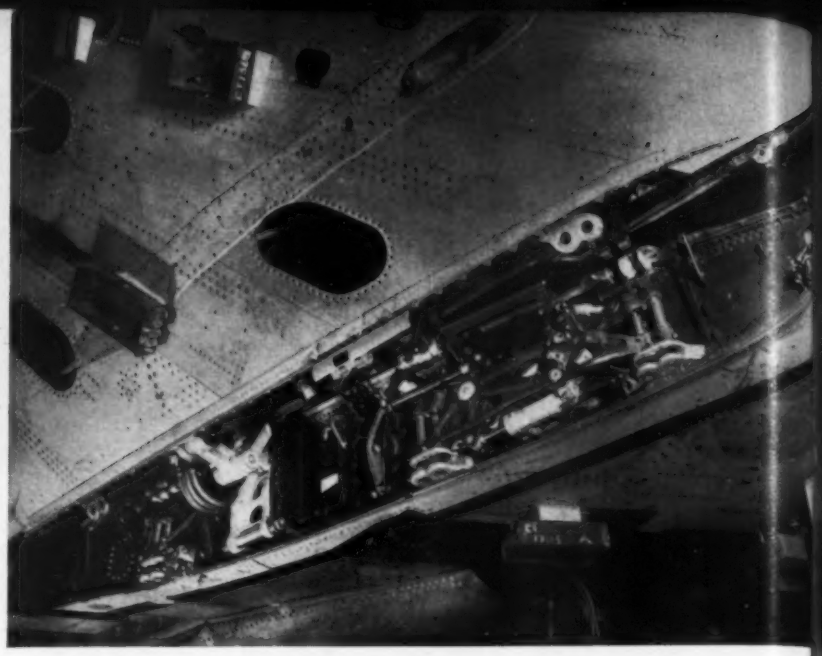
It was soon appreciated that a satisfactory solution was to fit an all-moving "slab" tailplane, in which the whole unit is employed as a primary control surface. Actuation of this type of tailplane requires fully powered operation at all times. When, in 1954, it emerged from the shops fitted with its all-flying tailplane, WG 240 was the only British aircraft so equipped. In addition, a variable gear ratio was incorporated which, at high speed, approximately doubled tailplane deflection for a given stick movement. It was also decided to adopt fully powered actuation for the ailerons and rudders, dispensing with manual reversion and incorporating fully duplicated systems on all surfaces, together with spring feel—and, on the rudders, Hobson q-feel in addition. It is likely that the final control system of the Sea Vixen is unsurpassed in its all-round effectiveness over the entire speed range from supersonic to below 100 knots.

The hydraulic circuits for the flying controls are energized by four pumps on a Rotol accessory box mounted between the Rolls-Royce Avon turbojets. Both port and starboard drive-shafts incorporate a free-wheel so that the box is driven by whichever engine is turning the faster. The loss of one engine, therefore, has no effect on control power, and the proximity of the engines to the centre-line of the aircraft obviates asymmetric problems. In the unlikely eventuality of both Avons failing, hydraulic power can be maintained by extending an emergency ram-air turbine and pump unit. All control surfaces are actuated by duplicate tandem Lockheed Servodyne jacks, the two halves of each unit being connected into separate hydraulic circuits.

All Sea Vixens are fitted with large Fowler-type area-increasing flaps, which run out in sections on each side of the tail booms. Selection of "flaps down" unlocks the rear portion of the tailplane from the leading portion. As the flap angle increases, so does this hinged section of the tailplane deflect upward to provide a considerable down-load, thus cancelling the trim-change produced by the flaps. The hinged portion of tailplane also behaves like a very powerful geared tab in that, as the tailplane angle is made more negative, so does the relative deflection of the hinged area increase. This, coupled with the fact that the neutral datum of the pilot's control column is displaced forward some three inches as the flaps reach the limit of their travel, allows the pilot to apply very considerable down-loads with the tailplane without stalling the surface. A full account of flying-control development with the de Havilland 110 prototypes was published in our issue of July 13 last year.

Another programme of trials, carried out largely on WG 240, was concerned with achieving the optimum pattern of air brake. Originally, there were relatively small castellated-edge surfaces hinged above and below the jet pipes, but it was soon apparent that this was not the best solution. In 1954 it was decided, after considerable investigation, to equip the aircraft with an air brake of the "barn door" type hinged beneath the centre fuselage. Operated by a hydraulic jack, this surface is extended downward

Two men to whom the Sea Vixen owes much: Mr. W. A. Tamblin, F.R.Ae.S., chief designer at Christchurch, and Mr. J. ("Jock") Elliot, chief test pilot (Christchurch).



On the right is a close-up of the starboard wing-fold, showing the latching mechanism. One of the pylon anchorages can be seen on the underside of the folded wing panel.

PROGRESS WITH THE SEA VIXEN . . .

and forward, the air load being balanced by jack force so that there is no limitation on its use.

Another aerodynamic modification to WG 240 was one which has since become quite familiar in one form or another on the majority of high speed aircraft. This modification consisted of drooping the outer wing leading edge to give a relatively blunt entry at a negative angle of incidence. This section of leading edge is separated from the remainder of the wing by a fence, and it improves low-speed handling qualities and maintains good lateral control right down to the stall. It also has an advantageous effect on general handling at a high angle of attack at extreme altitude, but incurs no measurable drag penalty.

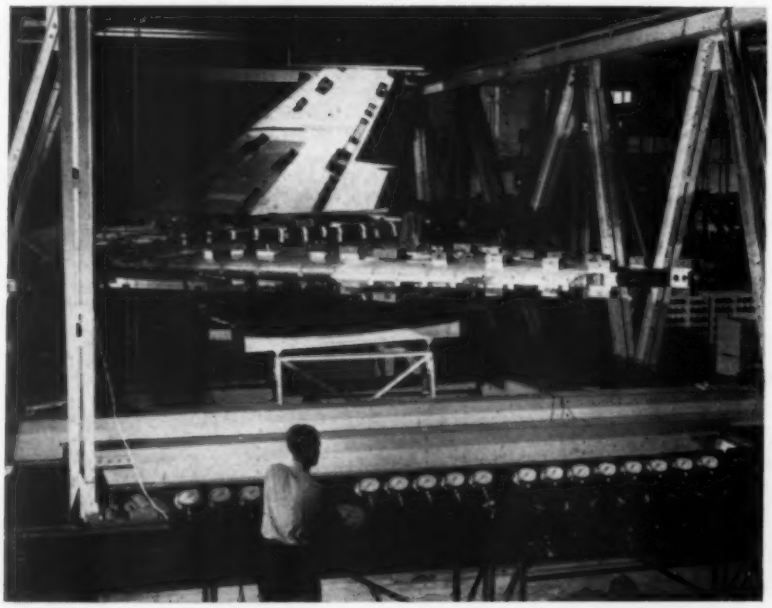
For carrier use, provision is naturally made for catapulting and arresting. In the Sea Vixen catapult hooks are fitted beneath the roots of the main wing spar. This is a particularly good location, for it allows the towing bridle or strop to be widely spread, giving excellent longitudinal stability during acceleration. Installation of an arrester hook has also been accomplished very efficiently by virtue of the twin-boom configuration of the aircraft. The hook is attached to a strong frame at the rear of the powerplant bay and can be lowered hydraulically to a position in which its pull acts almost in line with the centre of gravity of the aircraft.

Although it was not then equipped for catapulting and arresting, WG 240 underwent preliminary "touch and go" carrier trials from H.M.S. *Albion* in the autumn of 1954. These trials sufficed to show that the general handling of the aircraft would prove adequate for carrier operation—in fact, its behaviour was quite outstanding. The pilot was Lt.-Cdr. "Jock" Elliot, who is now chief test pilot at the Christchurch factory.

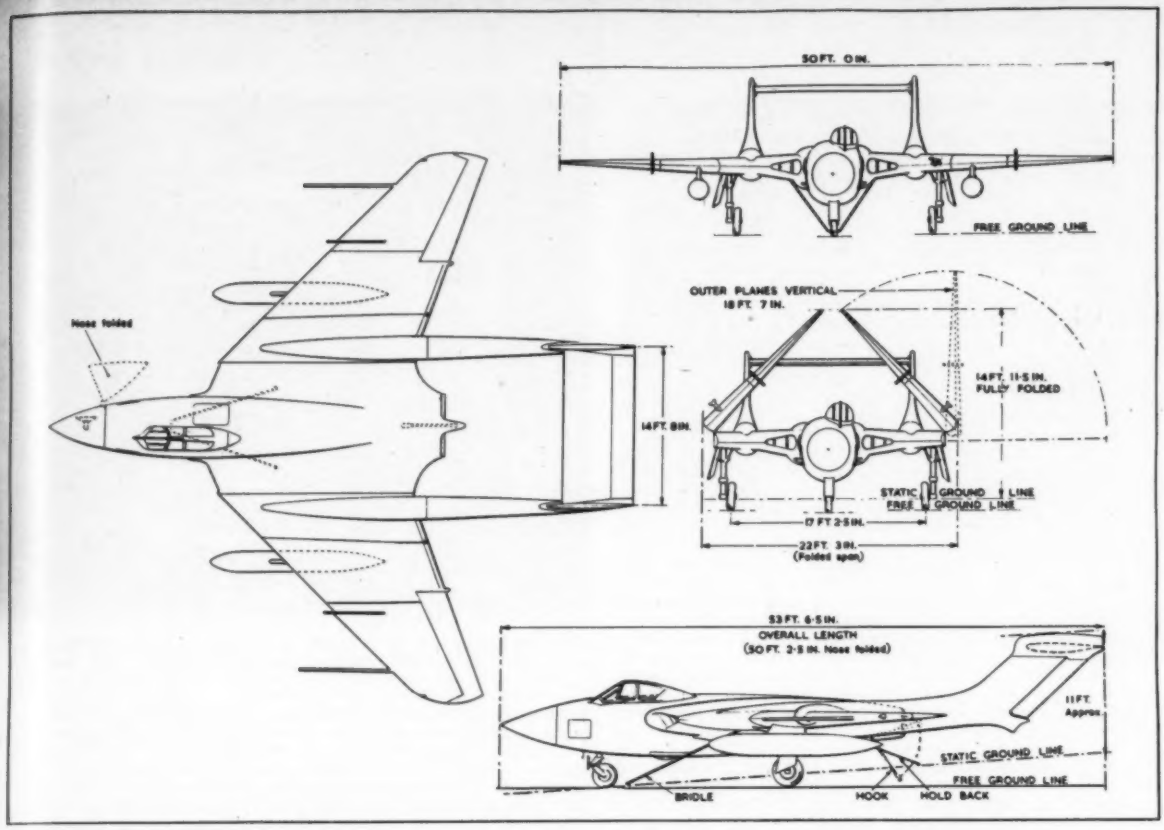
By this time work was well advanced on the construction of an intermediate development aircraft equipped for deck-handling, catapulting and arresting, but retaining non-folding wings. Other design changes introduced with this machine included more powerful engines (assembled through the top of the powerplant bay instead of through the bottom), a dielectric radar nose, a sharp "vee" windscreen to improve rain-shedding, and a deeper canopy allowing the pilot to sit two inches higher on the approach and thus obtain a better view. There were also several design changes which are not externally obvious, but which combined to make the aircraft a considerable advance on WG 240. Much of this machine, the serial number of which is XF 828, was constructed at Christchurch. It first flew on July 20, 1955, some seven months after the production order was placed.

Following the numerical system established with earlier de Havilland naval aircraft, the production Sea Vixen (which bears the naval specification number N.139) was given the mark number of 20. The intermediate semi-navalized prototype was therefore termed Mk 20X. Its general behaviour on a simulated deck was evaluated early last year at the R.A.E., Bedford (Thurleigh). Then, on April 5, Lt.-Cdr. S. G. Orr, D.S.C., A.F.C., R.N., commander of the naval test section at the A. and A.E.E., Boscombe Down, flew the Mk 20 to H.M.S. *Ark Royal* and there picked up No. 1 wire to make the first arrested landing. During the ensuing days three R.N. pilots from Boscombe Down, as well as Mr. Elliot, put the aircraft through a full series of carrier trials, from which it emerged with complete success. Among the factors investigated were approaches and landings, accelerated and free take-offs, and overshoot action on one engine with "everything down." Lack of asymmetric thrust renders the latter relatively simple.

For positive manœuvring on the deck the incorporation of a hydraulically steerable nosewheel is one of the design changes made on the Mk 20. Other changes include folding wings; lengthening of the stroke of the main undercarriage legs to provide a great increase in maximum energy absorption; inclusion of Dunlop "Maxaret" anti-skid brakes, and wheels having tubeless tyres; a re-designed form of main wheel-well door which closes behind the gear when the latter is in the down position; and the introduction of a pointed radome (better to resist rain erosion) capable of being power-hinged to starboard to reduce the aircraft length when going down a



A complete Sea Vixen wing is here about to be tested—structurally and for folding—in the structural test house at Christchurch.



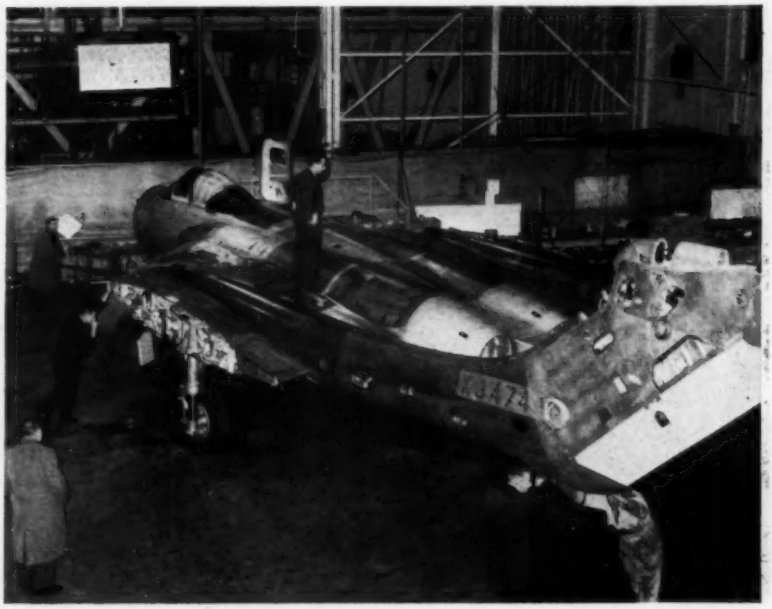
All the quantitative Sea Vixen data that can be published are contained on this maker's g.a. drawing, the first to show the final configuration.

carrier lift and to provide perfect access to the radar. Incorporated on XF 828, and carried through to the production series, are solid metal bumpers beneath the ventral surfaces at the rear ends of the tail booms. These bumpers are equipped with hydraulic dashpots to give a degree of resilience in the event of the maximum possible angle of attack being reached at touchdown. In addition, the finalized Sea Vixen design has tail booms kinked upwards through 3 deg to give the pilot even greater ground-angle latitude.

The de Havilland Sea Vixen FAW.20 is now in full production for the Royal Navy. The first series-built aeroplanes are initially coming through the shops at Christchurch. When all foreseeable problems have been eradicated, responsibility for main production will be passed to the company's biggest aircraft production unit at Chester, whose task is the relatively straightforward one of making essentially similar aircraft to the agreed schedule. Some of the airframe components for the first few aircraft have been purchased outside the de Havilland organization, but with few exceptions — Folland-built wings, for example—later airframe components will be made within the Enterprise, several detailed components being supplied by the Portsmouth factory, and the undercarriage legs being products of the Propeller Company's works at Lostock. The first completely navalized Sea Vixen has the serial number XJ 474. It recently flew for the first time and is in all respects a fully-developed production aircraft.

One of the most important of the new developments built into this aircraft is the folding wing. Much of the engineering of the wing-fold was undertaken at Hatfield. The proportion of each surface which folds is considerable, the hinge axis coming just outboard of the tail boom. As a result the angular movement of the folding portion is no less than 110 degrees, in order to conform to the height imposed by carrier stowage limitations. Hydraulic jacks are used to pivot the folding sections directly upwards about two principal spar hinges. Highly-stressed attachments are of steel and the hinges are bolted to heavy diffusers which disperse loads into the machined wing skins. This type of skinning is employed in heavy gauges throughout much of the wing, and exceptional attention has been paid to structural integrity. Countersunk or dimpled rivet holes are most carefully prepared and a radius is put on the edge of every hole and at every change of section. A high proportion of the stiffening members are special extrusions which are riveted, bolted or bonded to the machined outer skin.

The radome and pilot's canopy are large and advanced



Since this picture of XJ 474 was taken other Sea Vixens have reached a similar state of assembly. The general finish is outstanding.

PROGRESS WITH THE SEA VIXEN . . .

examples of the plastic engineer's art, and both are de Havilland products. The canopy comprises a blown hood assembled in a magnesium-alloy frame. The windscreen is formed from multiple glass laminates raked back at an acute angle. The radome is one of the largest fitted to a fighter and covers the latest and most powerful British interception radar equipment.

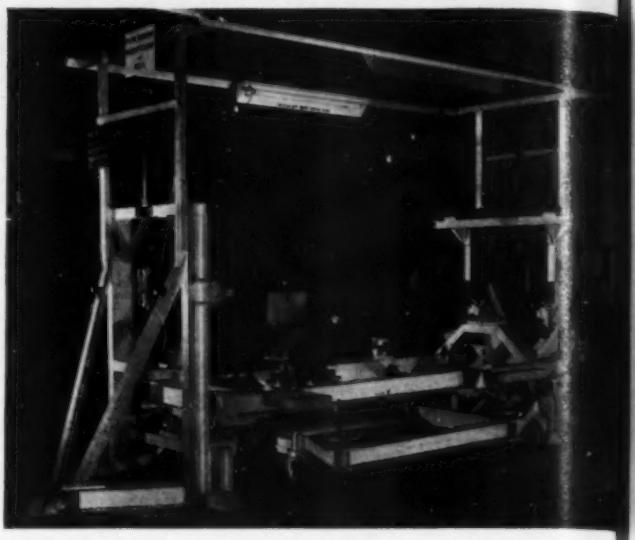
Both pilot and observer have Martin-Baker lightweight Mk 4 ejection seats, which, even at supersonic speed, can fire in a trajectory well clear of the tailplane. Crew ejection on ditching and under water has been studied and fully proven. Both crew members are comfortably seated in the pressurized and air-conditioned crew compartment, and the pilot has an outstanding view, especially to port. The observer, who enters through a forward-hinging hatch above the starboard side of the fuselage, can navigate, monitor the radar, warn the pilot of any incorrect instrument readings and also undertake such tasks as operating the wing-fold.

As already noted, the powerplants are Rolls-Royce Avons. The original aircraft had relatively early engines of about 7,000-7,500 lb thrust apiece, but the Mk 20 has late-model Avons with a much higher rating. Both units are housed in fireproof bays, which, by virtue of the unusual configuration of the aircraft, bear very little stress. This has facilitated the provision of exceedingly large access doors and, in fact, the whole upper surface of the engine bays can be unfastened to allow the complete powerplants to be lifted out and replaced in less than three hours. Hydraulics are virtually excluded from the proximity of the engines, and the majority of the electrical units are mounted above the wing where they are free from dirt and oil. Special provision is made for rapid servicing under difficult conditions, and all removable components are grouped in package form wherever possible.

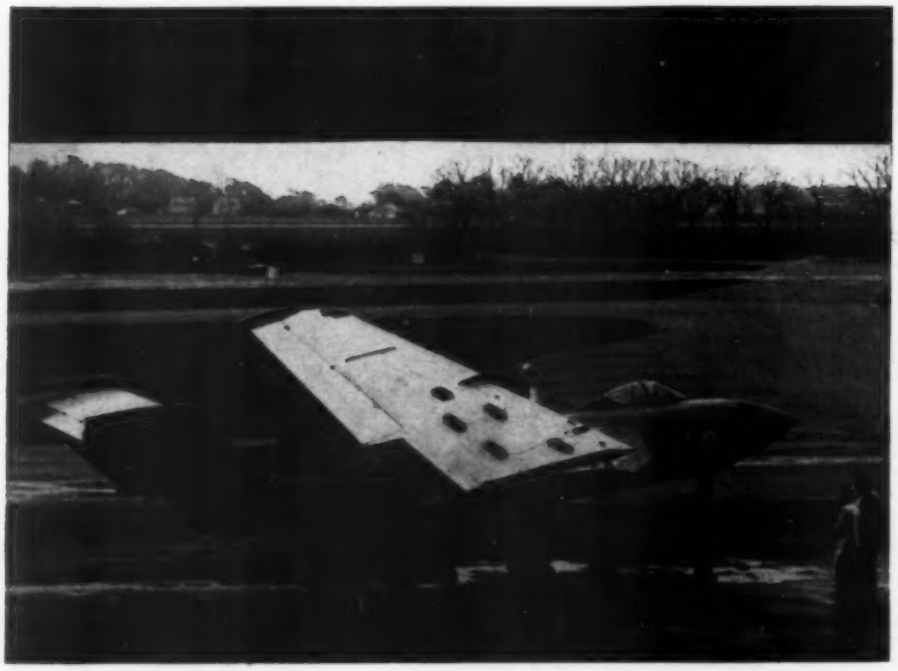
Substantial internal tankage is provided between the intake ducts and within the wings. The Sea Vixen 20 is also provided with several standard under-wing pylons, two of which can be equipped to carry additional tanks. Provision for flight refuelling takes the form of a long probe positioned on the port leading edge inboard of the wing fold. The Mk 20X has successfully completed "dry contacts" in conjunction with a Canberra from the Tarrant Rushton airfield of Flight Refuelling, Limited. A valuable characteristic of the Sea Vixen is its ability to carry heavy and varied loads of stores. Two years ago it was announced that a standard underwing load could comprise four air-to-air guided weapons, and there is reason to believe that considerably more weighty combinations of stores could be accepted. Moreover, whether the aircraft is intended to fight with guns (which are not, incidentally, in evidence on XJ 474), spin-stabilized rockets or guided weapons, its performance and radar ability should suffice to put it in the right place for a successful attack.

Altogether the Sea Vixen is a machine of outstanding potentiality. Its generous wing area confers excellent performance and manœuvrability at all altitudes and has also made possible the achievement of extremely good slow-flying and landing characteristics. Moreover, the basic flexibility of the aircraft is such as to allow it to develop progressively to meet future demands, and it could undoubtedly accomplish several types of mission quite distinct from the primary rôle for which it has been designed.

It is natural that the Royal Navy are eager to get the Sea Vixen into service; but before this can be done a formidable programme of development must be completed. As de Havilland state: "Plans for the new aircraft in production form to embark on a final series of carrier trials have already been made. These will be supplemented by further testing at Ministry of Supply establishments. Finally, before the aircraft can be accepted for squadron service, it will be necessary to assess weapons, radio, radar and navigation systems under a wide range of service conditions. Equipment supply and servicing problems must also be investigated." When this work is done Sea Vixens should be relatively plentiful, and the Fleet Air Arm will be markedly strengthened by their entry to first-line squadrons.



The fuselage boxing jig has a removable keel, which is raised off its vee blocks with the assembled fuselage and wheeled to the next stage.



Forming an interesting aesthetic comparison with the heading picture on p. 433, this view is suggestive of the compactness of the Sea Vixen when folded for carrier stowage. As we reported last week, this fully navalized machine flew for the first time on the evening of March 20. The pilot was Jock Elliott and the observer Mr. R. Adams; they reported that the 36-minute flight was completely successful.

Jet Transport Operation Problems

A T.C.A. Appraisal—Part 2

LAST week we published abstracts from the first part of the notable paper read recently by Mr. J. T. Dyment, chief engineer of Trans-Canada Air Lines, before the Weybridge and London Airport branches of the Royal Aeronautical Society. Here we give further excerpts.

In the first instalment the layout of airports for jet operations was examined. Discussing the speeding-up of passenger handling on the apron, and complications caused by the jet-blast factor, Mr. Dyment considered that in cases where it was possible to do so, taxying the aeroplane straight into a nose dock attached to the terminal building was the most desirable; where it was not practicable to have the necessary servicing facilities in the terminal nose dock, the conventional method of taxying and swinging around and stopping near the terminal was most likely to be used at the majority of airports.

T.C.A. is considering the use of a mobile conveyor-belt unit similar to those used [continued Mr. Dyment] for loading and unloading high compartments, but the unit would comprise three belts which could be moved sideways on the vehicle so each belt could be presented in turn to the baggage-compartment opening. The combined capacity of the three belts would hold the contents of one compartment. As soon as loaded, this unit would move quickly by its own power to the passenger baggage collecting point where it would discharge its load by the movable belts. The actual distribution of the baggage to the passengers in a matter of seconds is not an easy problem, but the automatic self-serve method used at the Los Angeles airport goes a long way towards clearing this particular problem.

An intensive analytical study by the airline is sorely needed as to what it is trying to accomplish and what it needs to achieve its objectives. A time-and-motion study of existing terminal procedures and of mock-ups of proposed facilities, and greater familiarization of the architect with the day-to-day problems at a terminal, are all essential to evolve a design, or redesign that will be satisfactory for the coming traffic.

It is obvious that many airport terminal buildings will have to be remodelled immediately, or new ones built between now and 1960 or 1961, otherwise the building facilities will become the bottleneck in this modern era of mass high-speed transportation. In analyzing future requirements, provision should be made for continual expansion. It appears inevitable that, within the next twenty years, long-haul rail passenger traffic will become just about extinct, at least on the American continent.

Another small but important point in relation to terminal design is that, if the civil operators continue to use kerosine rather than JP-4 as a fuel, the building will have to be air conditioned, because the windows on the ramp side must be kept closed to keep the fumes out. The air-conditioning intake will also have to be well shielded from the fumes.

This problem need never arise if the airport authority, Customs, immigration and the airline officials work together to avoid it. I recall seeing over 450 passengers handled in 40 minutes at San Juan, Puerto Rico, a few years ago and the speed of handling was due not to the number of officials but entirely to the enthusiasm and complete co-operative spirit that existed between the government airport manager, the head of Customs, the head of immigration, and the Pan American Station manager. Everyone was imbued with the idea that no one must ever be able to accuse anyone at San Juan with being slow or disinterested. They were the most efficient group I have ever seen, and demonstrated that the problems can be solved. [When asked later for his opinion of London Airport's passenger-processing, Mr. Dyment said it was "just marvellous."]

Meteorological Requirements. The actual met. information required for the forthcoming turbine era will be little different than it is today, but the penalty of not having the information at the time it is required can impose a much greater economic penalty. Apart from the increased altitude band with which we are concerned, the new problems are to provide the airlines with a good knowledge of the velocity and boundaries of jet streams, the location and intensity of gust areas, and the ambient temperatures from sea level to 45,000ft.

Safety will be more adversely affected than it is today, because of the greater speed of jet transports, unless met. offices get together and issue the same weather information about a particular area from all points. Right now, operators using different met. sources for planning flights, substantially along the same track at approximately the same time, may file inconsistent flight plans because the information provided by these sources sometimes differs. As a result, initial separation between aeroplanes may be incorrectly assessed. It is essential that measures be taken to ensure accuracy and uniformity in the forecast information provided.

Artist's impression of a DC-8 in T.C.A. livery.

The larger the fuel reserve that must be carried to cover deviations due to changes in forecast weather, the greater will be the cost. It must be remembered that 26 gallons is equivalent to a passenger in weight, yet will fly the aeroplane for only one minute. Accuracy in forecasting is thus even more important than today.

There is no place in air transportation where the payload can be as easily affected as it can by calling up more fuel reserves. At the present time T.C.A. plans to start its DC-8 services carrying 7,900 lb of fuel reserve solely as a route factor. Such a reserve is in addition to the normal reserve of 9,600 lb for one hour's holding and 9,000 lb for diverting to an average alternate.

There is one redeeming feature about jets—the elapsed time between when the forecast is made and when the weather is encountered can be almost halved from that of today.

Because the fuel penalty involved in a missed approach (about 2,000 lb) or a diversion to an alternate airfield is so great (9,000 lb), it is essential that terminal forecasting of visibility under marginal conditions be most accurate. It is still not possible for a ground station to tell a pilot the actual visibility range he will have as he approaches a runway. Some device is needed to measure "slant visibility."

Air Traffic Control. Many believe this to be the toughest problem facing air transportation today. The introduction of jet transports into service will make it worse.

Because of the speed of the new jets (or even current aeroplanes), dependence on visual flight conditions to avoid collision is entirely inadequate. Airborne collision warning radar has been found impracticable to date, with little hope of improvement on the basis of present knowledge. Planning an A.T.C. system must, therefore, not count on aeroplanes avoiding each other through the use of any airborne equipment alone. It is hoped that efforts will continue to solve the problem of airborne collision radar, because when perfected it will provide a monitoring back-up device similar to that provided by G.C.A. during regular I.L.S. approaches for landing.

The most difficult A.T.C. problems occur in the areas where aircraft converge or are climbing and descending, and that is what a jet aeroplane does best. It does not like to fly for long at a constant altitude. It wants to climb as it burns off fuel. This accentuates the problem for A.T.C.

For maximum efficiency, a turbojet aeroplane would like to take off and climb in an unrestricted manner, as quickly as possible, to its initial cruising altitude of around 30,000ft (preferably climbing in the direction of its destination). It would then like to continue to climb slowly (drift-up) as it burns off fuel during cruise. At the appropriate point, depending on the distance to the destination and the altitude, it would like to descend at constant Mach Number straight into a landing.

Any deviation from this ideal flight plan costs additional fuel. However, it is obvious that both traffic and adverse weather conditions will dictate departures from it. The desire is that any departure from it will be a minimum. The type of departure having the least adverse effect on fuel would generally be one in a lateral direction.

Since both lateral and vertical separations will be required, it is essential that improved altimeters be developed with much

JET TRANSPORT OPERATION PROBLEMS . . .

greater accuracy at high altitudes, both from the standpoint of safety and to conserve airspace. An accuracy is required to permit separation levels of not over 1,000ft.

Long-range navigation for high speed aircraft requires rapid position-fixing. Since astro-navigation, at the present state of the art, is not practical, heavy concentration on the development of auto-navigational systems such as Doppler and Inertial is under way for use on long overwater flights. The long-range navigation system should have an accuracy such that the position-fixing error will not exceed 10 n.m. at least 95 per cent of the time.

For flights over land, the short-range navigational facilities such as V.O.R. and D.M.E. used to date would require continual switching from station to station with the high-flying jets. A low-frequency visual system will probably have to be developed for *en route* flying, with the V.H.F. systems used for the terminal areas.

In order that jet traffic can be co-ordinated with the aircraft at the lower levels the whole descent path needs to be adequately defined, including the initial position of descent. There is another problem in relation to holding. The jets will require an area holding different from that of the reciprocating-engined aeroplanes, even though they may follow the same general pattern of orbiting. The bottom of a jet stack (and we hope such a stack will seldom exist) will probably be at 20,000ft, because the jet will burn too much fuel orbiting at a lower altitude; at the same time, it need not come lower because it can drop into the approach pattern from 20,000ft at a rate of from 3,000 to 5,000ft/min.

Ground surveillance radar with a range of at least 120 n.m. is desirable for monitoring the descent from 45,000ft to touch-down, but it is essential for the efficient functioning of A.T.C. and to expedite the terminal area movements.

I.L.S. will be required at all airports served by jet transports. Even with the latest type of equipment there is a very definite need to have a continuous distance indication throughout the approach. Although greater accuracy is needed during the final approach the same equipment could probably be developed for common use as a short- and medium-range navigational aid.

Precision G.C.A. is also desirable at all airports served by jet aircraft. G.C.A. itself needs little improvement, but its operators need considerably more practice in its operation than they now get at some places.

The new A.C.L.S. (automatic carrier landing system) being developed by Bell Aircraft for the U.S. Navy shows great promise, with over 1,200 blind landings made with it to date. This device would be most welcome as a supplement to complete the landing automatically after an automatic I.L.S. approach. It has been stated that A.C.L.S. can land any aeroplane equipped to use I.L.S.; and commercial production could be available in two years.

Planning for jet aeroplane operations has revealed few really new needs in telecommunications but it has revealed the extent to which current operations are handicapped by existing facilities.

The routine reporting of an aeroplane in many areas is associated with its geographic location. Doubling the speed of the aeroplane either halves the time between position reports, or the aeroplane must omit reporting over locations so close togeher. This, as can be imagined, can lead to political prestige problems in areas like Europe, because every country wants to control aeroplanes over its territory. The problem of co-ordination between ground-to-ground and air-to-ground services is tremendous, and a solution has not yet been found.

The Aircraft. The airlines believe, and hope, that the least of our worries concerned with jet transport operations will be the aeroplanes themselves. This is partly due to the pioneering efforts of de Havilland and B.O.A.C., but chiefly due to the tremendous amount of research and development going into the design of the new big jet transports. There are, however, a few points that are worrying some of the airlines.

An important feature of the jet aeroplane is that the simplicity of its engine operation permits the cockpit to be designed from scratch on the basis that the aeroplane can be operated solely by one man. A second crew member would, of course, be available as a stand-by, or to assume certain duties in normal conditions.

The problem is to get some of the airlines, the manufacturers and government authorities of the United States into this frame of mind. They have been imbued for so long with the concept that any aeroplane weighing over 80,000 lb needs a third crew member that they no longer analyse the situation impartially.

Those who have made studies, and this includes some U.S. manufacturers, agree that a jet aeroplane can be designed to relieve the work load on the crew to such an extent that the aeroplane can be safely operated with a two-man crew. Whether or not a particular aeroplane requires a two- or a three-man crew will, of course, depend upon the manner in which the designer has treated the design of the cockpit in that aeroplane.

We feel that one cannot overstress the importance of achieving simplicity in a cockpit design, and the importance of reducing the dependence upon the human element to a minimum.

Weight and c.g. Control. Aeroplane fuselages have become so long that a real problem prevails even today in distributing the baggage and cargo load so as to keep the c.g. within permissible limits. The complexity of achieving this quickly, particularly where there are last-minute changes to the load, is a real problem. The development of a low-cost electronic computer—an electric Librascope type of device—is very much needed.

Take-off "Go-No Go" Indicator. Because a jet aeroplane is covering ground so quickly during the latter part of its take-off run, too much of the runway may be covered before the pilot recognizes that all is not well. It would, therefore, be most helpful if some indicator could be made available to let the pilot know throughout the take-off run whether or not the acceleration of the aeroplane is as it should be. Such a device has been tested experimentally but is not available.

Fuel Control Unit. Because kerosine is the cheaper in some areas, and JP-4 (wide-cut gasoline) in others, it would be helpful if the operator could use either, even to the point of adding one to a part tankful of the other, with the fuel control system adjusting itself automatically to the prevailing specific gravity.

The Rolls-Royce Conway fuel control can do just this, as it compensates automatically to the specific gravity of the fuel over a range wide enough to encompass both types of fuel. The problem is to accomplish as much with all civil turbine engines.

Fire Prevention. Because a turbojet does not have a propeller to strike the ground in a crash and stop the engine, the rotating parts might in some accidents continue to spin. This means that fuel vapours from burst tanks could be drawn into the engine by the rotating compressor and ignited by the hot turbine wheel.

It has also been demonstrated that, regardless of the fuel used—JP-4 or kerosine—a quick fire can occur if a high-speed impact results in fuel being splashed, or sprayed, as small particles which come in contact with a hot part of the engine.

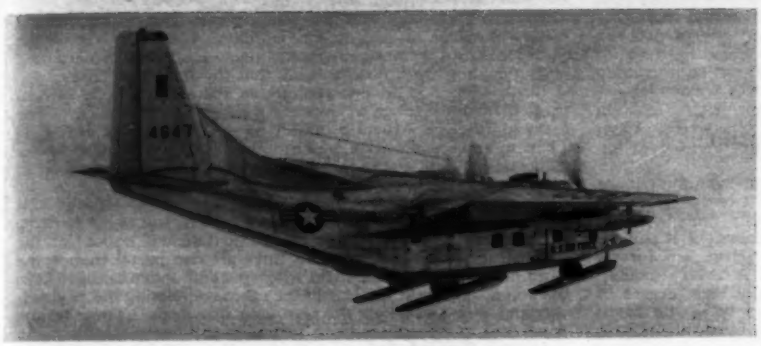
The N.A.C.A. has developed a means of preventing such fires by automatically and instantaneously spraying all hot parts of the engine with water when a crash occurs. It is sincerely hoped that both the engine and aeroplane manufacturers will continue to study how best to reproduce in a practical light-weight manner what the N.A.C.A. has accomplished with an installation that is a bit too heavy for normal service. The question also remains—will an accidental discharge of the water on the hot parts damage them?

Jet-engine Noise. Noise suppressors capable of achieving a ten-decibel noise reduction have been designed and are expected to weigh around 300 lb per engine. Even more efficient noise suppressors (18 db reduction) have been tested, but so far have had too much adverse effect on performance. The industry is still hoping for a good practical design somewhere between the two.

Thrust Reversers. Manufacturers have evolved designs that permit the pilot to obtain in a reverse direction 50 per cent of his normal forward thrust with no loss of engine thrust when the device is not in use. The reverser is expected to weigh around 250 lb per engine. The manufacturers are a bit handicapped in designing both the noise suppressor and thrust reverser, because their installations must be compatible with each other. There is ample scope for ingenious designers in this field.

IDEAL FLIGHT PROCEDURES—T.C.A. FLEET

Procedure	Viscount	Vanguard	D.C.8
Take-off weight (lb)	60,000	141,000	287,500
Flap setting: (deg)	20	20	25
V_2 speed (1.15v_s): (kt)	112	129	151
Level-off to attain climbing I.A.S. of (kt)	180	170	290
Climb at this I.A.S. to altitude of (ft)	18,000	20,000	27,000
Average rate of climb (ft/min)	750	1,200	1,700
Continue climb to initial cruising alt. at T.A.S. of (kt)	—	—	450
Initial cruise altitude depending on weight (ft)	—	—	32-35,000
Climbing cruise T.A.S. at 1.19 L/D	—	—	476 (195,000 lb) 482 (280,000 lb)
Maximum altitude (ft)	—	—	40,000
Descent: long-range procedure			
T.A.S. (kt)	—	—	480
Down to altitude of (ft)	—	—	36,000
Then continue descent at I.A.S. (kt)	—	—	260
Down to altitude of (ft)	—	—	1,000
Rate of descent (ft/min)			
Long range	—	—	1,700
Normal	2,000	25-3,200	4,000
Emergency	7,000	—	—
Circuit and manoeuvre at 1.3v_s (kt) I.A.S.	140,130	130	143
With flap setting of (deg)	20	20	15
Final approach at 1.3v_s I.A.S. (kt)	120	120	131
With flap setting of (deg)	40	40	50



The striking fighter/research aircraft (left) is the Nord 1500 Griffon II canard, propelled by a SNECMA Atar/ramjet combination. The Griffon II is referred to in an item on this page ("Nord Experimental Aircraft"). The Fairchild C-123 (below) has a wheel/ski undercarriage and is also referred to on this page.

AIRCRAFT INTELLIGENCE

Great Britain

Bristol 200. A total of four American sources can now be cited as having published references to a new jet transport project with this designation. All speak of it as a short to medium-range machine, and two state that it is designed to be powered by four of the new Bristol B.E.47 engines, each of 6,000 lb thrust. The Bristol Aeroplane Company have made no allusion to such a project.

Handley Page Turboprop Heralds. According to the Italian journal *Alata*, Handley Page are interested in the General Electric T58 free-turbine engine, of about 1,000 s.h.p., as a powerplant for the Herald transport. At the same time an Australian operator has indicated that a projected Herald variant may have two Rolls-Royce Darts.

U.S.A.

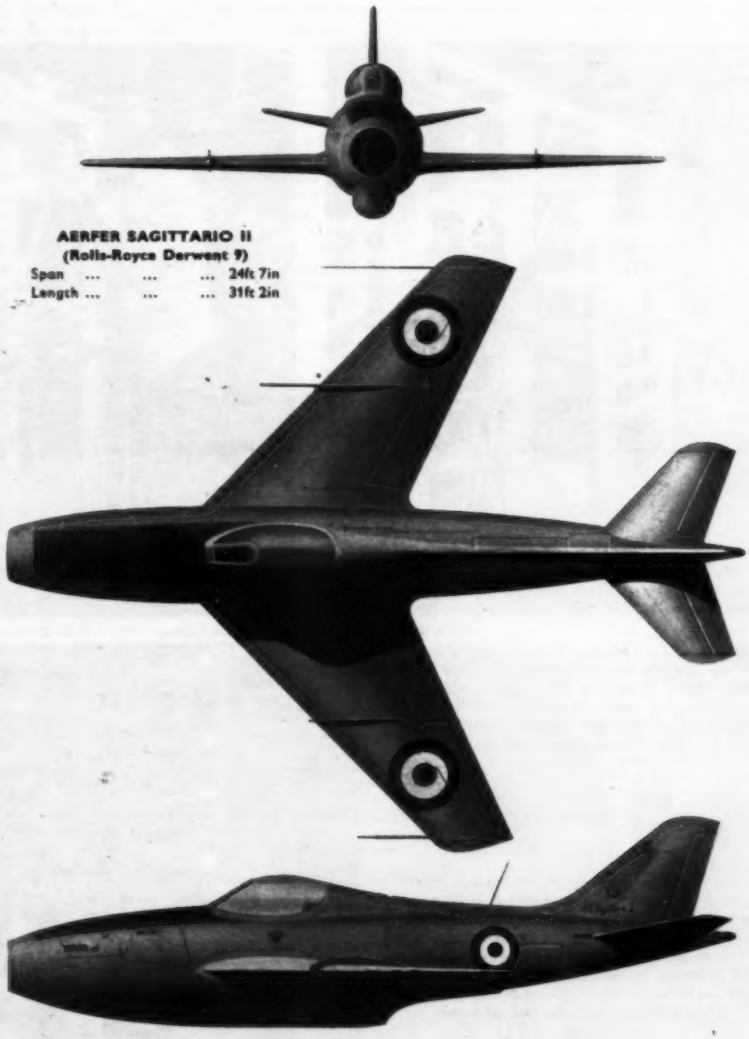
Fairchild C-123. Illustrated on this page is a C-123 assault and logistics transport equipped with a newly developed wheel/ski undercarriage. This machine recently took off and landed at gross weights approximating 56,000 lb. Fairchild are at present modifying a version of this aircraft to take a J44 turbojet at each wing-tip, and a number of machines with the new undercarriage and powerplant are scheduled for the Northeast Air Command.

France

Dassault Etendard VI. Last of the three related sub-types of Etendard to fly, the prototype of this machine began its flight trials last month. It is powered by a single Bristol Orpheus. Other Etendards are the II, with twin Turboméca Gabizos, and the IV, with an Atar. Both the latter aircraft flew last July.

Nord Experimental Aircraft. The following outline of Gerfaut development has been received: The Nord 1402 Gerfaut I first flew on January 15, 1954, and underwent initial tests before receiving a new, smaller, wing and tyres of lower pressure. This was the first aircraft to exceed Mach 1 in horizontal flight without power boosting, and was fitted with a SNECMA Atar 101C. The Gerfaut II, described as "a service version," flew on April 17, 1956, and at present holds the world's record for climbing speed. This machine has a SNECMA Atar 101G with afterburner. Another experimental delta-wing machine, the Griffon I (formerly the Guépard) flew on September 20, 1955. This was intended for studying a new airframe design which could be equipped with a combination ramjet/turbojet propulsion unit. The Griffon II flew on January 23 this year and is actually the airframe of the Griffon I modified for the testing of a different propulsion unit embodying a SNECMA Atar 101E plus ramjet.

S.E. Alouette Squadron. Six S.E. Alouette turbine-powered helicopters were recently shipped to North Africa aboard the same number of Noratlas twin-boom transports. They will form the first squadron to be equipped with the type. All French Alouette units will have fifteen machines, including three "replacements."



BUILDING THE E.P.9

Simple and Ingenious Methods for Quantity Production of the Edgar Percival Agricultural Aircraft

A VISIT these days to Edgar Percival Aircraft, Ltd., at Stapleford Tawney, Essex, reveals a veritable hive of activity (the *cliché* is really justified), with a packed production floor and a considerable line-up of completed E.P.9 agricultural aircraft. The advance in a period of less than six months—when the writer saw the pre-production line shortly after the S.B.A.C. Display—is very marked indeed and fully supports the company's claims. Although it is but a small factory, the aeroplane is so simple and the work is kept moving so well, that the elapsed time to build an E.P.9 is only nine weeks. Capt. Edgar Percival estimates that present capacity is equal to ten aeroplanes a month.

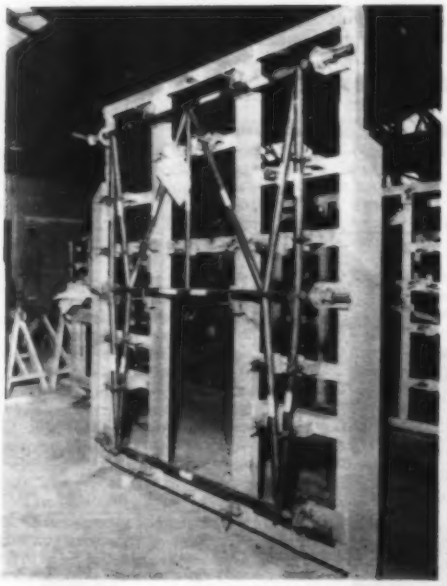
The fact that the E.P.9 is a strut-braced high-wing monoplane has a psychological effect in that it tends to make one overlook the fact that it is an all-metal aeroplane—the only exceptions are the fabric-covered tail boom and the wooden doors. The painted external surfaces and the welded tubular fuselage are further factors that tend to obscure the fact that it is a very modern aeroplane, fully tooled and with an unusually high degree of interchangeability. Components are made to fit in the truest sense, and such items as the mainplane and tailplane struts have no adjustments for length.

One somehow associates struts with adjustable fork-ends, yet the company's policy is undoubtedly sound. Bush operators do not want the task of levelling an aeroplane in the field and then rigging it to have 1 deg dihedral and 1 deg incidence, each ±15 min. The triangulation of two spar/fuselage fittings and the single lift-strut makes possible a spot-on rigid structure without any need for adjustment.

Modern knowledge makes it practicable to fabricate the welded tubular fuselage as a precision component, so that one of the traditional causes for rigging adjustments has gone. So accurate is the welding work on the E.P.9 that the tail-boom framework is being offered as an interchangeable spare that can be offered up to the front fuselage for welding without special fixtures. The forward fuselage structure, ahead of the main portal frame, is likewise replaceable as a spare. This standard of accuracy is achieved by close attention to detail in design and the method of manufacture.

Fuselage Manufacture. The "pod-and-boom" fuselage is made entirely of welded T-45 steel tube. The somewhat curious, if eminently practical, shape entails an unusual layout for the basic structure. Fundamentally, there are two portal frames, the front main one taking the main wing spar and undercarriage loads, the secondary one at the rear of the cabin completing the payload-carrying zone and taking the rear wing spar loads. These frames are boxed in by side and top members to form the cabin, with a low-set forward-projecting framework under the cockpit (to which the engine bearers are attached) and the high-set tail-boom framework.

This apparently complicated structure is, in fact, made from a number of simple plane frames that are assembled and welded



Figs. 1 and 1a (above). The main portal frame of the fuselage in its welding jig. The left-hand photo illustrates the whole component with the parts ready for welding, while in the right-hand picture the work is nearing completion. Note the six plugs locating the bores of the cross-tubes.

Fig. 2. Typical locating point on a welding jig, with the tube held by a Speedtools toggle clamp in a vee welded to a plate which can be adjusted for height.

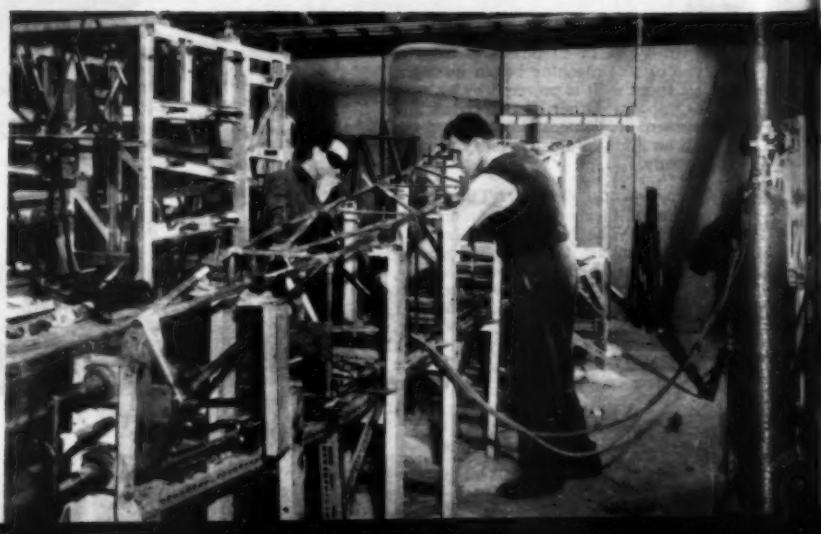


Fig. 3 (right). Welding the tail-boom structure. The upper and lower plane frames are complete when put into this jig. The work of "boxing-up" the unit is started at the tail diamond-plate and is worked forward in a precise sequence to obviate distortion. Note the rigid location of the diamond plate, which is the anchorage for the tail surfaces.

"Flight" photograph

The Edgar Percival E.P.9 agricultural and general-utility aircraft (270 h.p. Lycoming GO-480-B1B flat six): agricultural useful load, 2,080 lb.

in vertical jigs. These welding fixtures are sturdy affairs made from channel and angle sections, assembled by welding and bolted to the shop floor.

The main portal frame (Fig. 1) is typical, although more robust than the others, because the tubes are the largest in the fuselage and can, therefore, exert greater distorting forces when heated. This particular frame has three main cross-tubes, which are held in the jig by steel plugs that are slid into the bores from six key fittings on the jig. The verticals, and the diagonal brace tubes, are slipped into place between the main members, where they are carried in vees held by toggle clamps.

The tube supports (Fig. 2) are of a neat standardized form. The vee-block is a piece of angle-section welded to a plate, which is, in turn, mounted on the jig frame by three welded bolts. The three-point attachment of the support plate makes it easy to align. A piece of large angle-section welded on the frame forms a base for the quick-acting Speedtools toggle clamp.

Tube lengths are parted by a flexible abrasive disc cutter, after which the ends are trimmed to fit the joints. Most joints are made without gussets, but certain of the major ones have plates inserted along the diameter of some of the tubes.

After tack welding of all parts, welding is carried out in carefully planned and empirically evolved sequences to minimize distortion while hot and to ensure that the finished component is within the close limits needed for 100 per cent interchangeability. As far as possible, where the part is symmetrical, the equivalent left and right joints are welded simultaneously.

The tail boom starts life by being welded as upper and lower plane frames, with small-diameter cross-tubes and diagonal braces welded to the continuous longerons. The finished upper and lower units are next put into the fixture shown in Fig. 3, where they are attached to the diamond-shaped tail plate and the verticals and braces are added to box the sub-assembly. Welding is started at the rear, the "closed" end, and is worked forward. This is a unit which is offered as an interchangeable spare.

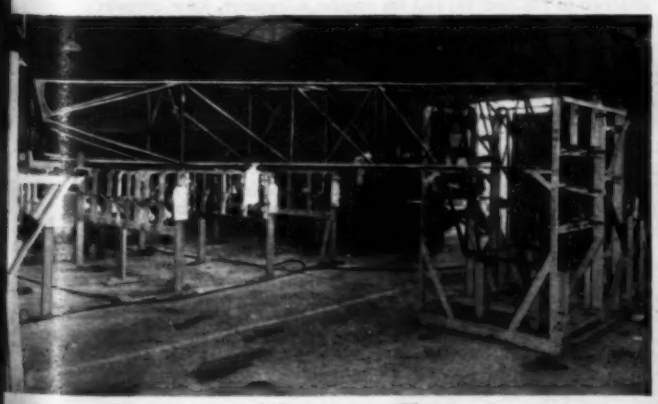
The several plane frames and the tail boom are assembled in the jig shown in Fig. 4 for completion of the fuselage. Here the wing-root attachments, the top cross-members of the two portal frames, are rigidly located by mandrels in their bores. The engine-bearer attachment points are likewise located directly when the front-fuselage frames are offered up. The rear of the tail boom unit is also located precisely, not by the diamond plate, but by saddle blocks round the lower longerons. Other main tubes of the cabin and front fuselage area are held very rigidly by saddle blocks; these are not just cramps, but are precision fixtures held by pinned mandrels (Fig. 4b). The front undercarriage attachment cross-tube is located by a mandrel in the bore, but the rear one, which shares the lower cross-tube of the main portal with the wing strut, is left free.

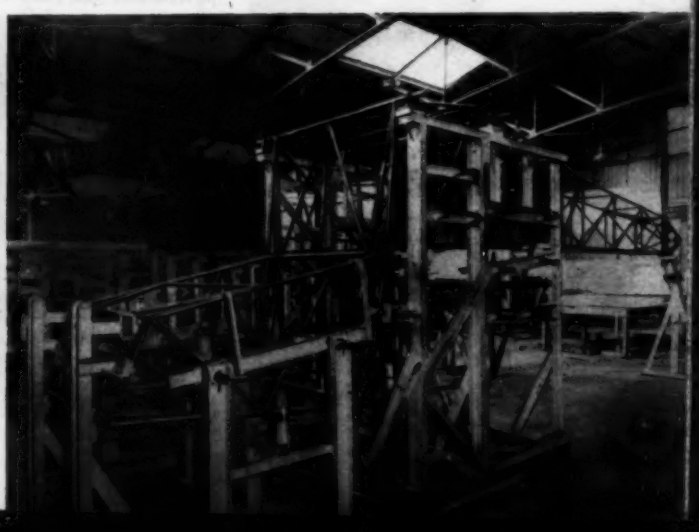
After removal from the jig certain small details are added, including the tubular cockpit frame and the box members which form the floor bearers.

After welding, the fuselage framework is removed from the jig to the checking fixture. This is simply a set of sturdy fixtures in the floor which hold the fuselage by the tail, undercarriage, wing and engine-bearer attachment tubes while it is given a "rigging" check by a centreline, plumb bobs and trammels. While in this jig, the bores of those cross-tubes which accept the plugs of the wing and undercarriage fittings are reamed, with the aid of a simple guide mounted on the outer diameter of the tube itself. These plugs, which are of "B" fit, extend well into the tube, so that the welded joints are relieved of shear loads.

After completion of welding, the joints are cleaned up by wire brush and the framework goes into the paint shop, where it is treated with Jenolite rust-preventative and an etch primer before being sprayed with aluminium paint. The whole of the tubular structure is carefully sealed. During each welding operation each joint can "breathe" into the next tube through a drilling inside the weld area, and the sealing continues progressively into the main cross-tubes. Here the final closure is made with the taper-pinned spigots of the wing and undercarriage fittings. In the very few cases where the fuselage tubular structure is not sealed by weld-

Figs. 4a and 4b. The main fuselage assembly jig, in which the tail boom is attached and the cabin and the forebody frames are "boxed-up" to make the complete fuselage. Points of interest are the mandrel-type cramps used to hold the sub-assemblies and to locate the wing-room cross-tubes. The engine bulkhead frame is not only very precisely located for welding, but is also checked for interchangeability; the engine-mounting bolt-holes are drilled from a special jig before the fuselage is removed.





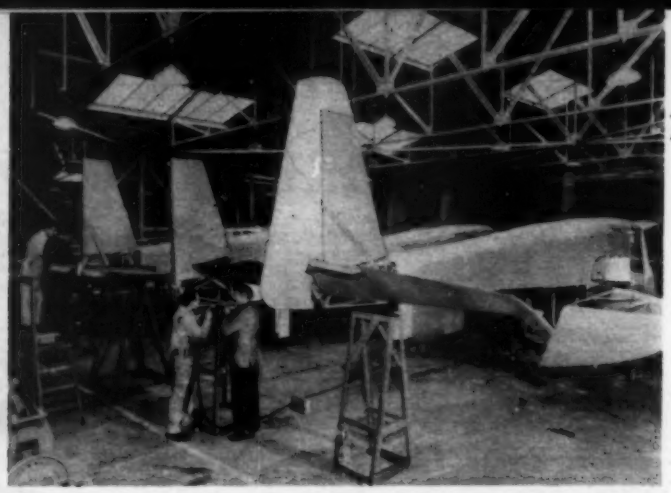


Fig. 5 (left, above). Finishing work on firewall and engine mounting of aircraft No. 37.
Fig. 6 (right). The part of the fuselage assembly line at which rear door, metal skin, glazing, engine bay and tail unit are added.

BUILDING THE E.P.9 . . .

Fig. 7. Cutting mainplane rib blanks on a Wadkin radial-arm router. The metal is "stacked" on the Hydulignum routing templates, so that several are cut at once.

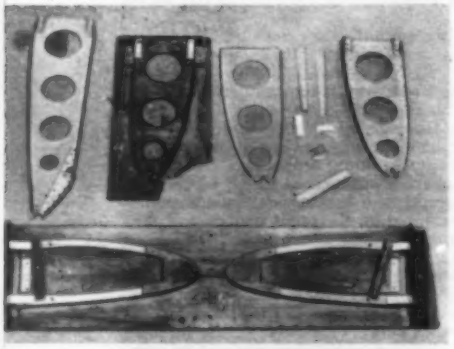


Fig. 8. Sheet-metal details and drill jigs: in the foreground are leading-edge ribs in their metal-bushed Hydulignum jigs. In the background, from the left, are a main-rib rear section and the drill jig and parts for (extreme right) a completed main leading-edge rib.

Fig. 9. Drilling the main spar. A Dexion framework carries angle-iron jig framework upon which the parts are held by modified Speedtool clamps, here seen keeping the extruded spar flange in place. The drill plate is of bushed Hydulignum stiffened by an angle-iron spine.

Fig. 10. Jig-drilling a rear spar-tube for the rib rivet holes. On the other side of the bench a leading-edge tube can be seen in its jig.

ing a lanolin compound is used to prevent internal corrosion.

From the paint shop the fuselage framework goes on to the fuselage assembly line—which is really the beginning of the final assembly line. It is supported in flying position by a tail trestle made from Dexion angle-sections and by jacks at the undercarriage fittings. Most of the work consists in offering up prefabricated details, but there is some fitting to be done.

The firewall—complete with engine control cross shafts—is put in place to form the front boundary for the skin panels. These, having no compound curvatures, are made in the flat of light-alloy sheet, to which drawn stiffeners are Pop-riveted. The cabin roof, apart from the cockpit roof-lights, is of metal—and has been made more robust than the rest to withstand rough usage from the mechanical hopper-filler.

The cabin floor is a robust structure, since there are no main structural tubes across it between the front and rear portal frames. Under-floor box members are attached to the Flexoply floor itself, which is a sandwich of end-grain balsa and plywood with metal facing. At cut-outs and other points of stress concentration in the floor there are spruce inserts. The cabin floor fits in as a unit, but the cockpit floor is in port and starboard sections—made up as complete assemblies with the flying controls—and is mounted after the fore-and-aft central girder of the cockpit has been fitted. This latter is a box beam with flanged lightening holes and it serves as the support for the flap lever.

The instrument panel and the engine control assembly are other units which are added complete. The engine bearers, of simple classical welded form, are bolted to the front of the firewall and the ignition harness, and at this stage details are added (Fig. 5).

Meanwhile the rear of the fuselage has also been receiving attention. The tail boom, from just behind the hopper hatch to the tailplane, is fabric covered. To give it a good shape, spruce formers and stringers are first attached to the tubular framework. There is no sewing after the fitting of the "bag" by adhesive. The fuselage goes to the paint shop for doping and an external coat of chromate protection on the metal-skinned areas.

Next, the tailplane, fin, elevator and rudder are added (Fig. 6). The fuselage then moves down the line, gathering control runs, the rear clamshell door, undercarriage, tailwheel and so on—until it is complete and ready for the wings. The engine is added at a latish stage, since customers have the choice of models with plain or chrome-plated cylinder barrels. Each airframe, nevertheless, receives its cowling panels, which are, of course, attached to the bearers; and the engine accessories, inter-cylinder baffles, air filter box, etc., are prepared in readiness for quick attachment to the engine.

The Wings. The parallel-chord wings are of extremely simple design for rapid, economic manufacture.

As the whole of the trailing edge is hinged, in the form of slotted flaps and ailerons, the rear of the main structure is of shroud form. There is a single spar at about 30 per cent chord, with light tubular members at the leading edge and the shroud to hold the closely-spaced ribs together.

The L.72 light-alloy ribs are divided into front and rear parts. The main ribs are press-flanged from routed blanks and are stiffened by riveted channels. The intermediate ribs, and those of the tank bay, are made up from pressed channel flanges.

Edgar Percival Aircraft cut the blanks on a Wadkin router (Fig. 7). The cutting jigs are of Hydulignum, with mild-steel guide-templates. Skin rivet holes are drilled from the cutting templates. The parts are sent out with their Hydulignum press tools for flanging on a rubber platen press, and when they come back they are put into simple Hydulignum assembly jigs (Fig. 8) for drilling and preparation for riveting. It will be seen in the

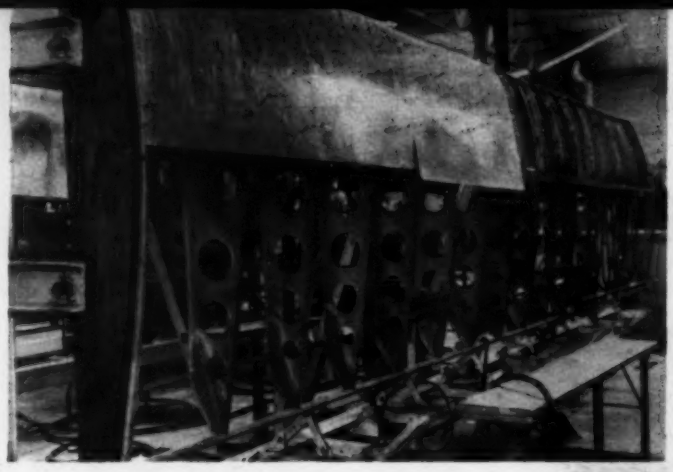
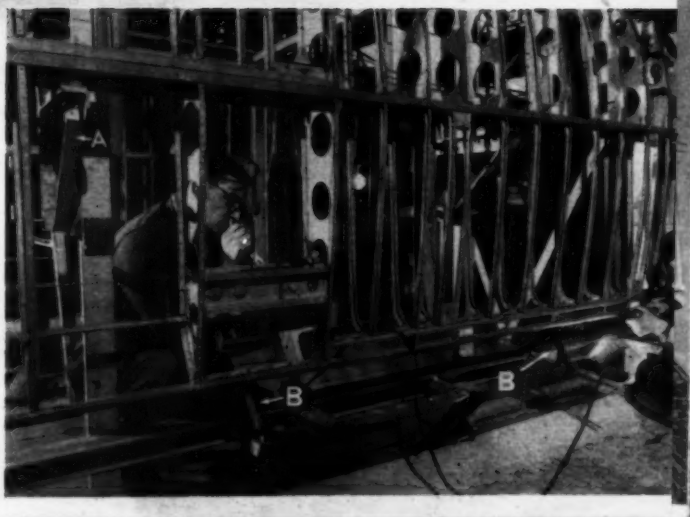


Fig. 11 (left, above). The port mainplane assembly and skinning jig from the wing-tip end. The profile board holding the outermost rib and the hinged supports for the rear spar-tube are clearly visible.

Fig. 12 (right, above). Inboard end of the starboard mainplane, showing the spar root-end location and the tank-bay rib structure, which is pre-assembled as a structure with its rear false spar.

Fig. 13 (right). Detail work on the framework of a port mainplane. A indicates a main-spar support and B the hinged rear-spar supports.



photograph that, although the main rib webs are of thin material —20 or 22 s.w.g.—the spar attachment fittings are neat, rigid little forgings, pre-drilled for both rib-web and spar-web rivet holes. The rib blanks and their stiffeners are drilled together from the bushed drill-plate of the jig, but the fittings are used as masters to drill both the web and the stiffening doubler.

The wing spar consists of a plate web with extruded-angle flanges, doubled to form a T where the strut loads are diffused. The web is assembled—in sections with butt-strap joints—on a table-type fixture with the extruded flanges and end fittings. Bushed Hydulignum drill boards are used. The parts are held in position by toggle clamps similar to those on the welding jigs (Fig. 9). After removal from the jig the parts have their holes de-burred and interfaces treated with anti-corrosive compound before they are brought together by rivet clamps. All rivets are inserted and their heads secured with Sellotape; and the components are then riveted in a Broom and Wade pneumatic squeeze riveter. The skin-attachment holes are drilled in the flanges with the aid of a metal drill-plate cramped to the spar.

The leading- and trailing-edge spars are simply plain lengths of tube, which are jig-drilled (Fig. 10) for the rib-attachment rivets. With the spar tubes and the ribs pre-drilled, individual rib supports in the jig are eliminated. The root end of the rear spar-tube receives the spigot of the fuselage-attachment lug.

The assembly of the wing is a simple business—greatly facilitated naturally, by the similarity of the ribs in the parallel chord.

The main spar and the rear spar-tube are located precisely at the root ends by dummy fuselage attachment fittings and at the tips by tooling holes in the wing-tip attachment rib and a profile board (Figs. 11 and 12). The main spar (Fig. 13) is supported against bowing at intervals by pads on removable brackets (A), while the rear spar-tube is similarly braced by simple hinged brackets (B). It is then a case of offering up the ribs and locating

(*Concluded on page* 446)

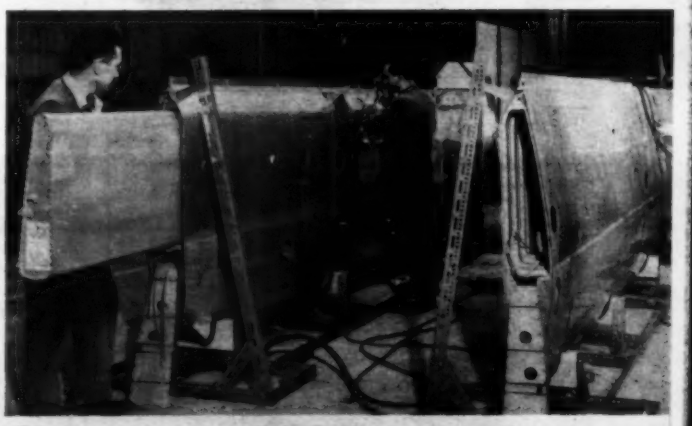


Fig. 14 (right). Finishing fixtures for the mainplanes. The skin is here closed with the pre-assembled flap and aileron shroud units. The tank is also put in and the wing root sealed.

Fig. 15. Although there are always new E.P.9s on the finishing line it is not a photogenic stage, because quarters are rather cramped. Seen here is the Manawatu Aerial Topdressing company's pre-production ZK-BDP.

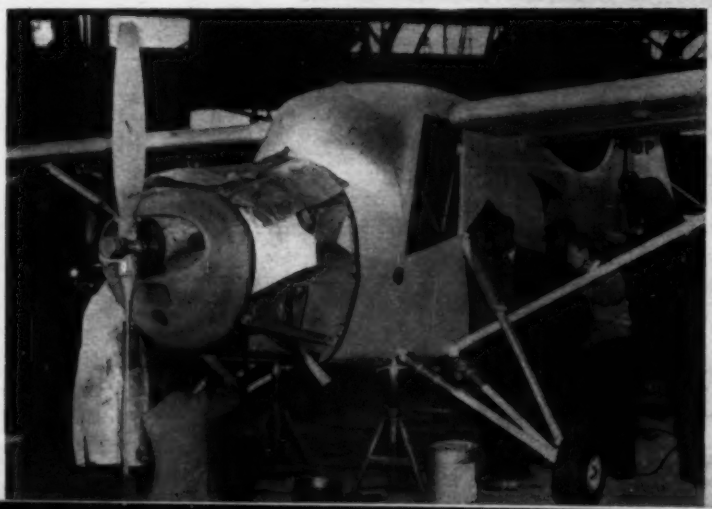
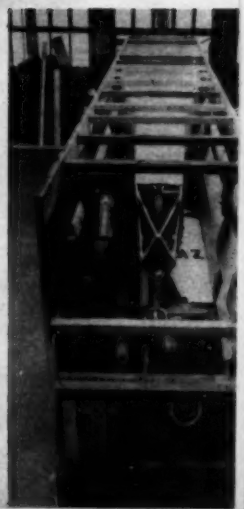


Fig. 16 (extreme right). Export aircraft entail packing. The Manawatu E.P.9 as crated by Blake's Wharves, Ltd., for the sea journey to New Zealand.



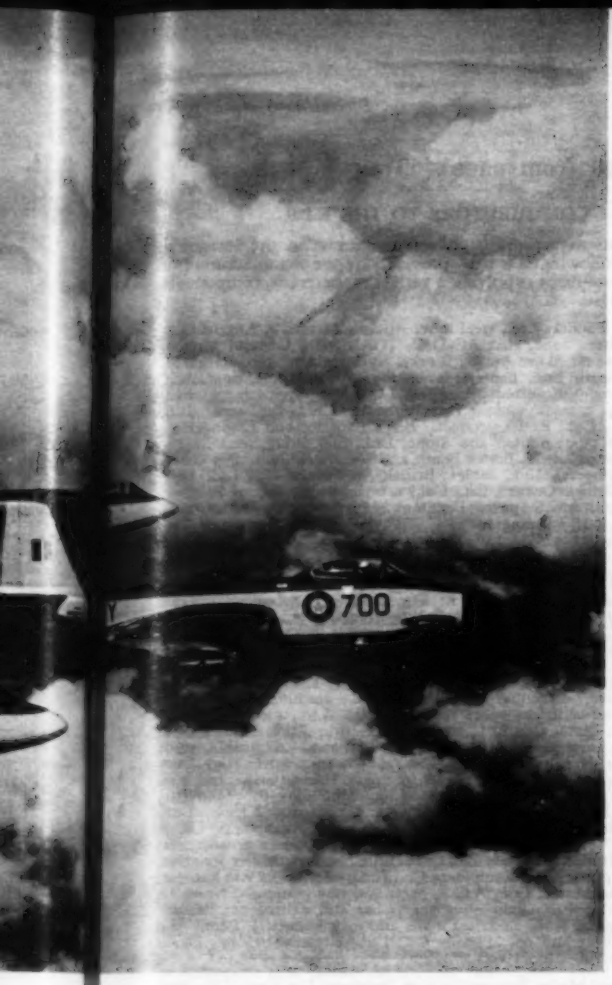
TRACKERS and BANSHEES

Impressions of New Canadian Naval Equipment

(Top left) One of the Grumman Trackers of the VX-10 Trials Detachment demonstrating characteristic method of wing folding.

(Left centre) A McDonnell Banshee, showing wing-folding geometry, radar nose and gun ports.

(Left) Banshee leading two Trackers. The Banshee was being flown by Lt-Cdr. A. A. Schellink, the port Tracker by Lt-Cdr. K. S. Nicolson and the starboard Tracker by Lt-Cdr. S. M. Rowell —all of the Royal Canadian Navy.



(Left) A Banshee leads two Sea Hawks. The Banshee is being flown by Lt-Cdr. A. A. Schellink, and the Sea Hawks (from No. 700 Sqn. F.A.A.) are flown by the C.O., Lt-Cdr. P. M. Lamb, and Lt. W. Conklin, U.S. Navy.

(Below) A Tracker is posed for our photographer by Lt-Cdr. K. S. Nicolson.

"FLIGHT" photographs

AT present carrying out flying trials aboard H.M.C.S. *Bonaventure* are the Grumman Trackers and McDonnell Banshees of the VX-10 Trials Detachment of the Royal Canadian Navy, under the command of Cdr. H. J. Hunter, R.C.N. After their transatlantic flight from Montreal last month, the unit was attached to No. 700 Squadron, R.N., the trials and fleet requirements unit at R.N.A.S. Ford, Sussex, who are carrying out a similar programme with Sea Hawks, Gannets and Avengers aboard the Canadian carrier.

From H.M.C.S. *Shearwater*, the naval air station at Halifax, Nova Scotia, and home base of the Canadian Navy's VX-10 experimental squadron, the *Bonaventure* trials unit flew to the R.C.A.F. Overseas Ferry Unit at St. Hubert, Montreal, in preparation for their flight to Britain—the first such movement by R.C.N. aircraft. Leaving Montreal on March 6, the unit flew by way of Goose Bay, Bluie West One and Keflavik, arriving at Kinloss, Scotland, on March 9. The two Banshees flew in company with R.C.A.F. Sabres; the two Trackers navigated individually and the ground maintenance personnel came in R.C.A.F. North Stars. The detachment arrived at Ford, its temporary base before joining *Bonaventure*, on March 11.

Before the ship trials began *Flight* visited VX-10 at Ford, to photograph its aircraft and to fly in one of its Trackers. The Tracker is, of course, the standard carrier-based anti-submarine machine of the U.S. Navy, having been designed as a combination hunter/killer aircraft to do the same type of work as our own Fairey Gannet. In Canada its components are licence-built by many firms, with prime responsibility vested in de Havilland Canada at Downsview.

It is a four-seater, powered by two 1,525 h.p. Wright R-1820 Cyclone piston engines, built by Canadian Pratt and Whitney. Canadian Trackers are designated CSF-1, and they are being delivered at the rate of about two per month. Those that we saw at Ford were two of the first to be built (VX-10 was the first R.C.N. unit to receive the type). An operational squadron of CS2F aircraft has now been formed and more are to be equipped during the next few months.

As can be seen from the illustrations, each pilot has a fine view forwards, downwards and to the side. The cockpit is neatly designed and the general handling qualities of the machine are well liked by the pilots (in particular, the wing spoilers give a most sprightly rate of roll). Inside the fuselage is a potent collection of electronic equipment, as befits an aircraft whose task is both to hunt and to kill submarines. Externally visible features include the starboard-wing searchlight, the retractable radar "dustbin", the sonobuoy housings in the rear of the engine nacelles, rocket rails under the wings and the magnetic detector unit in the tail (shown retracted in the photographs, this would be extended on its eight-foot boom during search operation). The Tracker is felt to be a worthy successor to the ageing but respected "Turkey"—the TBM Avenger.

It is now three years since the R.C.N. decided to replace its Sea Fury fighters with Banshees. Designed and built by McDonnell in St. Louis since 1945, the Banshee is a large single-seater, powered by two Westinghouse J34s of about 3,250 lb thrust apiece. The R.C.N. machines are of the long-range, all-weather F2H-3 model, armed with four 20 mm guns and with provision for future use of Sparrow II or Sidewinder missiles. For their transatlantic hop the Banshees were fitted with 150-gal tip tanks, giving an operational ferry range of 1,600 miles. Two squadrons of these machines are now operational with the R.C.N.

An interesting device being evaluated on these particular Banshees is the "Safe Flight" approach-speed indicator, which seems a most useful aid for carrier flying. The indicator itself, mounted to port above the cockpit coaming, comprises a pointer which remains in the vertical position when the pre-set correct speed is maintained, with a "stall" bar marked on the left and a "fast" bar on the right. The system is in effect a lift computer, with the desired approach-speed as a pre-set reference datum. The Banshees were set up for a normal approach speed of $1.18V_s$, with "stick-shaking" action cutting in at $1.05V_s$.

The carrier *Bonaventure* is fitted with steam catapults, interim angled deck and mirror sight, and the purpose of the present trials is to prove the ship's aircraft equipment in operation. A full series of catapult launches, at various weights and end-speeds, is included in the programme, and the VX-10 pilots have been familiarizing themselves with the use of the mirror sight by means of MADDLs at Ford. Following the trials, the aircraft will remain with the ship for her voyage to Canada, after which her operational squadrons—with similar aircraft—will embark.

BUILDING THE E.P.9 (continued from page 443)

them by their pre-drilled rivet holes, the pre-drilled leading-edge tube actually positioning the ribs. Items such as the tank-bay auxiliary spar and the flap-operating box unit are prepared as sub-assemblies.

The essence of the wing manufacture is that it is simply the riveting together of pre-drilled units; there is practically no hand work. The vertical jig gives completely free access from both sides and at quite an early stage the spar-supporting brackets can be taken away so that the wing framework is held only at the ends. The "plumbing" for the flying controls is added in this jig before skinning.

Except for the finishing of the trailing-edge shroud, skinning is carried out completely in the assembly jig. Because the wrap-around leading-edge skin is the more important aerodynamically, it is offered up first. The skin is cut to size, with a trim allowance, and is drilled back (full size) from the spar and rib flanges. The skin is next removed for deburring, the template routing of inspection holes and the riveting-on of stiffening flanges, trimming to size and, in the case of the leading-edge D-skins, chamfering of the lap joint. The skin panels are then replaced and riveted. The finish of the skinning is remarkably good—and one must remember that it is 24 s.w.g., save for the tank-bay, which is 22 s.w.g.

Upon removal from the jig, each mainplane is put, trailing-edge up, into a Dexion finishing fixture. Here the shrouds for the flap and ailerons are attached, the fuel tank is inserted and the root-end cover bolted in place. The completed wing is treated with a chromate anti-corrosion finish before painting to the requirements of the customer.

Smaller Components. The foregoing description has been written with the intention not only of describing the fuselage and mainplanes and their manufacture, but also to try to convey an impression of the general approach to the job—simplicity being the keynote all along the line.

The undercarriage vee, for example, is welded from two stream-lined tubes of T.45 tube, with a simple cross-bracing tube at the "base" of the vee. Sheet-steel fittings are welded for the fuselage attachments and the step. At the axle the tubing is stiffened by a welded wrapping plate, while the axle has a long spigot going well into the vee.

The tailplane and fin are conventional of their kind, scaled-down versions of the wing. The flaps and flying control surfaces are equally simple and conventional. They are all built on the D-nose principle, with a flanged sheet spar and ribs. The light-alloy skin is Pop riveted.

Final Assembly. The aeroplanes are moved from the end of the fuselage line into the next bay for final assembly.

Wings are offered up with the dead length lift-struts, i.e., there are four bolts to make—main spar, rear spar-tube and each end of the strut. The ailerons and flaps are added and the control runs coupled up. Full rigging checks are then made on the airframe and the flying controls. For the rest, it is simply a matter of detail work to complete the aeroplane.

Edgar Percival Aircraft, as such, is a new company; but it has many years of experience behind it. The premises are not large, but the whole design of the aeroplane and the planning for production are so thoughtful that one has complete confidence in the claim that present capacity is ten aircraft a month. Also, it is quite obvious that, both by sub-contracting and by expansion, this output could be quickly raised to meet any likely demand.

J. H. S.

CONTRIBUTORS TO THE E.P.9

In addition to various suppliers mentioned in the foregoing article, the following is a list—provided by the manufacturers of the aircraft—of firms supplying a variety of materials, components and services:—

Accles and Pollock, Ltd., steel tube; Aircraft Materials, Ltd., A.G.S. parts, steel sheet, tube, etc.; AC-Delco (Division of General Motors, Ltd.), fuel gauges; Acorn Spring Works, Ltd., springs; Aero Research, Ltd., glue; Amal, Ltd., flame trap; Antifyre, Ltd., fire extinguisher; Anglo-American Vulcanized Fibre Co., Ltd., fibre; Avica Equipment, Ltd., flexible hose; Aviation Developments, Ltd., Pip pins; B.B. Chemical Co., Ltd., Bostik products; Bell's Asbestos and Engineering, Ltd., asbestos tape; Benton and Stone, Ltd., fuel filter; Betta Manufacturing, aircraft labels; James Booth and Co., Ltd., light alloy sheet; Bowden (Engineers), Ltd., cables; British Aluminium Co., Ltd., light alloy sheet; British Oxygen Co., Ltd., acetylene gas; Brown Brothers (Aircraft), Ltd., A.G.S. parts; Bruntons (Musselburgh), Ltd., cables; C.A.V., Ltd., stall-warning horn; C.W.C. Equipment, Ltd., switches; Cork Manufacturing Co., Ltd., Langite jointing; P.B. Cow and Co., Ltd., rubber grommets; Curd Components, Ltd., A.G.S. parts.

Davis and Timmins (Aircraft), Ltd., A.G.S. parts and electrical equipment; de Havilland Aircraft Co., Ltd., A.G.S. parts and raw materials; Docker Brothers, cellulose, dope, etc.; Dover, Ltd., Doverising; Dunlop Rubber Co., Ltd., flexible hose, adaptor, compression rubber; Dzus Fastener (Europe), Ltd., Dzus fasteners; Faulkners, Ltd., forging for axle; Ferodo, Ltd., friction materials; Goodyear Tyre and Rubber Co. (Great Britain), Ltd., wheels, brakes, master cylinders; Greenpar Engineering, Ltd., machining, heat treatment, and sub-contract work; David Griffin, Ltd., electrical parts; Havant Sheet Metal Co., Ltd., sub-contract work; Thos. P. Headland, Ltd., A.G.S. parts and raw material; Hellermann, Ltd., cable, studs and strapping; Henshall and Sons, Ltd., sub-contract work; High Duty Alloys, Ltd., alloy sheet, tube and forgings; Hurst, Crisp and Co., sub-contract work; E. and E. Kaye, Ltd., light alloy tube and bar; Kelvin and Hughes, Ltd., instruments and compass; Kigass, Ltd., Kigass priming pump; H. Ling, electrical parts and instruments; Lodge Plugs, Ltd., sparking plugs; M.B. Metals, Ltd., ignition switches; Manganese Bronze and Brass Co., Ltd., Oilite bearings; Miller Aviation, Ltd., A.G.S. parts; Mills Equipment Co., Ltd., safety belts and harness; Nettlefold and Moser, Ltd., A.G.S. parts and raw materials; Northern Aluminium Co., Ltd., light alloy sheet, bar and extrusions; Parman Aircraft Supplies, Ltd., electrical items and instruments; J. Penny and Sons, steel sheet and bar; Plessey Co., Ltd., electrical wiring; David Powis and Sons, Ltd., rivets.

Ransome and Marles Bearing Co., Ltd., bearings; Leo Rapp, Ltd., steel bar, light alloy sheet, bar and tube; F. S. Ratcliffe (Rochdale), Ltd., springs; Renold Chains, Ltd., sprockets and chains; Reynolds Tube Co., Ltd., steel tubing; Rubery Owen and Co., Ltd., A.G.S. parts; L. A. Rumbold and Co., Ltd., seats; Sangamo Weston, Ltd., instruments; Self-Priming Pump and Engineering Co., Ltd., wobble pump; Shell-Mex and B.P., Ltd., oil and grease; Skefko Ball Bearing Co., Ltd., pulleys, ball races, bearings; Simmonds Aerocessories, Ltd., nuts; Smiths Aircraft Instruments, Ltd., flight, navigation and engine instruments; Southbourne Sheet Metal Co., sub-contract work; George Spencer Moulton and Co., Ltd., rubber hose; Stewart Aeronautical Supply Co., Ltd., A.G.S. parts, instruments; J. Stone and Co., Ltd., alloy castings; Suntex Safety Glass Industries, Ltd., Perspex mouldings, windscreens, etc.; T.I. Aluminium, Ltd., light alloy sheet; Tecalemit, Ltd., lubricating nipples and gun; Herbert Terry and Sons, Ltd., springs; Thermotank, Ltd., punkah louvres; Geo. Tucker Eyelet Co., Ltd., Pop rivets; Tufnol, Ltd., Tufnol materials; Tungum Co., Ltd., Tungum tube; Varley Dry Accumulators, Ltd., batteries; Vickers-Armstrongs, Ltd., fuel cock; Vokes, Ltd., air filters; James Walker and Co., Ltd., Nebar jointing; Western Manufacturing (Reading), Ltd., sub-contract work (rubber pressings); Whitehouse Industries, Ltd., nuts; W. Wilson and Sons (London), Ltd., light alloy sheet.

U.S. MILITARY AIRCRAFT: A NEWS ROUND-UP

FIGHTERS for the U.S.A.F. capable of exceeding Mach 2 are dubbed "Super Century" machines to distinguish them from the first-generation Century fighters (F-100 *et seq*). Two of the most important of the immediate programme concern the Republic F-105B and the North American F-107A, both single-seaters powered by a single Pratt and Whitney J75 (24,000 lb thrust with afterburner). It is probable that the F-105 Thunderchief will be ordered in quantity, in preference to the F-107, to keep Republic busy; the North American aircraft carries a heavier load (about 10,000 lb, compared with about 8,000 lb) but is fractionally slower.

North American are, however, likely to win the U.S.A.F. competition for a "medium-range" intercepter. This is to be a multi-jet machine weighing about 60,000 lb, smaller than the L.R.I. (long-range intercepter) project cancelled last year. The company are also promoting a civil (executive) variant of their "combat-readiness" trainer/transport. New data on this machine—a six-seater powered by twin General Electric J85 turbojets—are that it will be 43ft long, will have a swept wing of 42ft span, will weigh 14,000 lb and will cruise at about 500 m.p.h. at 45,000ft. The prototype of this aircraft is scheduled to fly early next year.

A decision is reported to have been taken on the high-performance observation aircraft contest for the Navy, Army and Marine Corps. Weighing some 9,000 lb and having a speed range of from 25 to 300 m.p.h., the winning design is either by Grumman or—again—North American. Powerplants are two G.E. T58s each of 1,000 s.h.p.

Yet another North American project is the supersonic A3J attack aircraft for the Navy. Powered by two General Electric J79s with afterburners, the A3J will be a two-seater weighing about 80,000 lb (the ultimate for a high-performance carrier-based machine). In addition the Navy have just issued a specification for a smaller carrier-based attack aircraft, matched with the Corvus (Crow) air-to-surface weapon under development by Temco.

Lockheed are reported to have developed an advanced, high-altitude early-warning machine, using four Allison T56 engines on an L.1649-type wing. It is expected to go into production for the U.S. Navy. The Navy have also asked for bids for a jet VTO machine; Bell and Ryan have put forward suggestions which may resemble the same firms' X-14 and X-13 (U.S.A.F.).

Mr. Masefield Looks Ahead

—in an R.Ae.S. Lecture on Probable Developments in Civil Aviation

THE case for the long-haul turboprop and prospects for the short-haul jet formed the theme of the lecture given on March 26 by Mr. Peter Masefield, managing director of Bristol Aircraft, to the Reading Branch of the Royal Aeronautical Society. At many points Mr. Masefield talked off-the-cuff and off-the-record, making this R.Ae.S. "main" lecture one of special value for the large audience.

Entitled *Present and Future Developments in Civil Aviation*, the lecture took the unusual form of being largely a commentary on a great many informative slides, some of which are reproduced on these pages. We give here some of Mr. Masefield's chief "on-the-record" points.

Having traced the development of civil aircraft to the present day, he warmed to the theme that the future held good prospects for both long-haul turboprop and short-haul jet. It would now be "fatuous," he said, for the British industry to follow in the footsteps of the big American jets. The U.S.A.F. Boeing KC-135 tanker programme was the reason why the Americans had the 707, DC-8 and Convair 880 today—a programme which had been indirectly supported by the U.S. Government to the tune of about £100m in dollars.

Where did we go from here? His own hobbyhorse was that the products for which markets would exist were the long-range turboprop and the short-haul jet. He was not, he said, "shooting down" the big jets—but they had a lot of problems: runways, noise, air traffic control, cost, weight—all were "major worries."

He showed a slide of a U.S. operator's dwindling net profit per dollar of revenue over the past few years, and noted that they, with other U.S. domestic carriers, were now pleading for higher fares.

Nearer home the cost per capacity-ton-mile for the various forms of transport were: Air, 36 pence; road, 5d; inland waterways, 4d; rail, 2d; sea, less than 1d. "We have got to get that air transport cost figure down," he said. The basic facts were that costs were proportional to the number of hours flown and to the number of landings made; and that revenue was proportional to distance covered and load factor achieved. To get lower costs we had to have higher annual utilization, long range, and only essential traffic landings. To get high revenue we needed high block speed to cover the maximum revenue miles, high load factors, and large attractive aeroplanes.

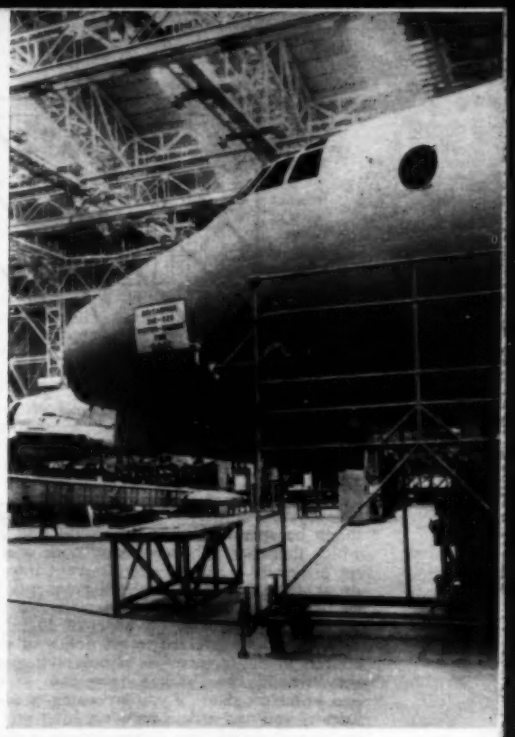
Generally speaking, high speed made it difficult to get high utilization in a working day of 18 hours, especially with bigger aircraft which were more difficult to turn round quickly. To illustrate the comparison in costs, Mr. Masefield used the basis of the formula/actual ratios recently commented on by Lord Douglas. These were: piston, 108; turboprop, 121; turbojets 135. He believed that a fare differential as between jet and turboprop was "very desirable." I.A.T.A. formalities were rather stodgy—not as individuals but, as a body, rather difficult to move. He said that a fare differential on the Atlantic route might save the air traveller as much as £40.

Mr. Masefield went on to compare the basic advantages of the turboprop and the jet, citing for the turboprop good range-performance, low noise level, simple A.T.C., cheapness; and for the jet, speed and simplicity. When comparing the two types in the long-range rôle there was a big proportional difference in the weight of installed powerplant, fuel and oil. (This is a subject pursued further by Mr. Masefield in a letter on page 452.)

To illustrate comparative take-off noise of future transports he showed a slide of M.T.C.A. measured external db figures showing the Britannias as by far the quietest aeroplane, the Comet 1 being the noisiest. The DC-8 or 707 would be off the map—being, he believed, 142 db. In speed the turboprop was "not going to be all that far behind the jets." About 480 m.p.h. was envisaged for Britannia developments, of which he illustrated two sketches. He referred to the recently shelved Douglas C-132, an aeroplane with a 200,000 lb payload which, if the traffic existed, "would get costs down to half present levels." He mentioned also the Bear, and wished we knew more about it. It cruised at a reported 510 m.p.h.—although he would "like to know the noise-level of the propellers."

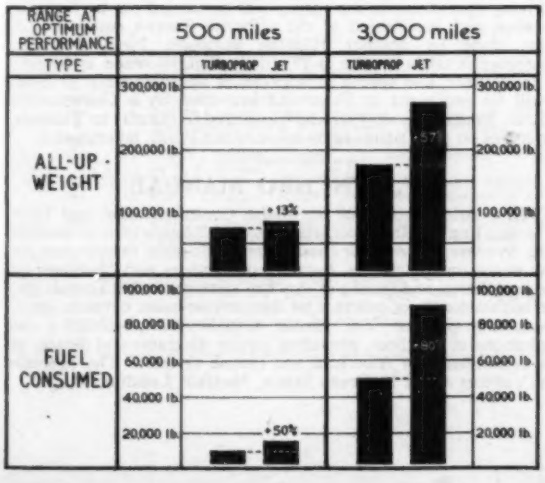
The case for the short-haul jet was its competitiveness, the fact that it was less critical on A.T.C., and that it was relatively light. For a 500-mile, equal-payload stage, comparison between turboprop and jet was about 70,000 lb and 80,000 lb—compared with 175,000 lb and 250,000 lb on 3,000 mile stages. For short ranges the jet was much more comparable in weight.

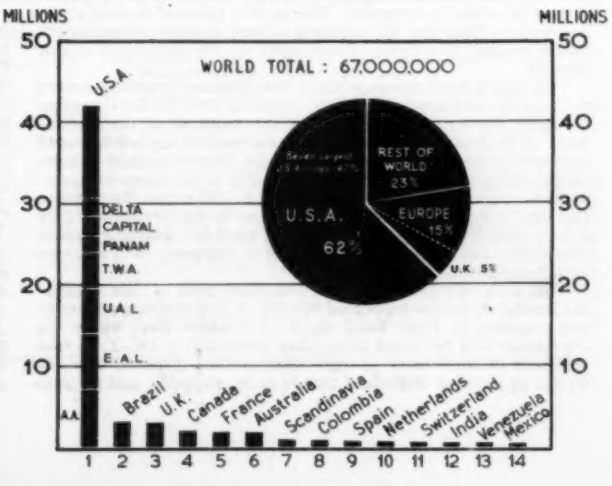
Mr. Masefield next examined some basic facts in the production and marketing of aircraft. Costs were simply proportional to man-hours worked and the number of aircraft produced; and revenue was simply proportional to the number of aircraft produced. Generally speaking, the time taken from basic design through development and production and entry into service was

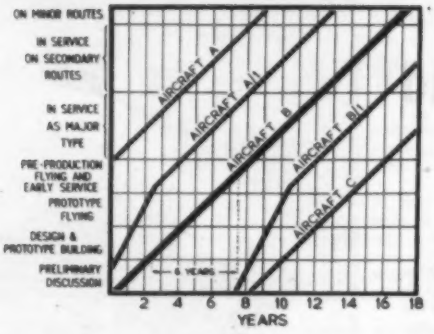


In the text Mr. Masefield refers to the policy of putting target-dates on production parts in the factory. Target for completion of this B.O.A.C. Britannia 312, unequivocally painted on the nose, is April 12. It may have to be changed as a result of the strike.

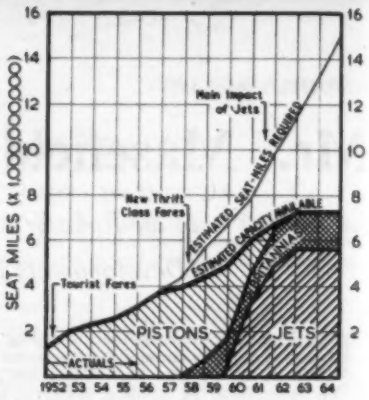
Left, weight comparison between jet and turboprop for different ranges, illustrating the small difference between short-range designs and emphasizing the economic case for the short-haul jet. Right, the world's leading air transport nations (passengers carried in 1955).







Left, a typical "equipment-time scale" of an airline. The aircraft types illustrated are hypothetical.



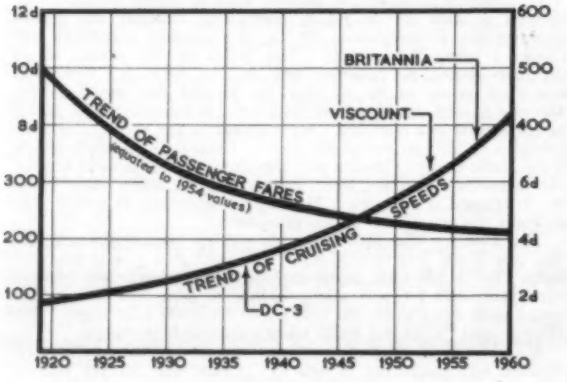
Right, Bristol's estimate of seat-miles required and available between the U.S.A. and Europe.

MR. MASEFIELD LOOKS AHEAD . . .

seven years—a period during which a sum approaching £70m might be spent. Unless one could find a fairy godmother ("of which there are jolly few about") one was going to be in the red for six years. But as aircraft went into service one came into profit, as customers completed payments from, say, 50 per cent to 100 per cent. Break-even point for the number of aircraft produced might be of the order of 80.

The lecturer referred to his policy of putting a date on every aircraft in the factory (see photograph, page 447). Production of the Britannia was broken down into 18 stages, and every stage had to have a date "if you are going to meet the customer." As long as you had a date on everything you knew where you were going and could take action before it was too late. The final stage had to have the first-flight date—the precise date, not just the month. ("Eventually we might even get the actual time.")

The trend in air transport cruising speeds (m.p.h.) and passenger fares (per passenger mile) during the first 30 years.



One of the biggest tasks was keeping suppliers up to the mark.

According to Bristol's estimate of Atlantic traffic growth and expected aircraft capacity (see illustration), a world shortage of capacity was becoming apparent "just about now, with a big gap in 1964."

Military and defence requirements, the lecturer concluded, were changing radically in "the most exciting industry in the world," but civil aviation was "moving from the dark into the dawn."

The Discussion. The lecturer was asked whether the turbo-prop would survive without a fare-differential. He thought so: it could achieve higher regularity over very long stages, with little difference in time, and could hold jets in tourist travel and perhaps on special types of first-class travel. Was Mr. Masefield optimistic about air cargo? No, he was not. An aircraft like the Douglas C-132 could get into the business of lifting large major commodities, but the fact was that air rates were much higher than surface rates. The right course seemed to be to carry freight in passenger aircraft, and he made an oblique reference here to the Vanguard when he said that there was only a small structure weight penalty for carrying around extra cargo space.

Sir Frederick Handley Page lightheartedly referred to Mr. Masefield's "propaganda." Anyone could see, he said, how essential it was to use the powerplant for getting L/D ratios up from the present-day figures of 17 to 30—an improvement which laminar flow through boundary layer control could bring about. Present-day aeroplanes *looked* all right, but what one couldn't see were the "invisible drag-parachutes" they were dragging along behind. Ranges of 6,000 miles could be increased to 8 or 9,000 miles with laminar flow, and a U.S.A.F. officer was on record as having said that had the B-52 got laminar flow it would weigh 200,000 lb instead of 400,000 lb.

Mr. Masefield agreed that the heart of any aeroplane was the powerplant, and recognized the great possibilities of boundary layer control even though "the flies and the rain might get in the way." But he felt that the biggest break-through would be when the problem of nuclear-shielding was solved. We were going to see in the future 1,000 m.p.h. aircraft with laminar flow, but it was nuclear power that might eventually be the answer to cheap supersonic travel.

Footnote: Two items of Britannia news in the lecture: Proteus overhaul life is now 850 hours and the Britannia 312 should be operating into New York by the end of July.

MAPPING BAFFINLAND

AT Oshawa Airport, near Toronto, a converted B-17 is being equipped for an aerial mapping survey of Baffin Island, to be undertaken by the Photographic Survey Corporation on behalf of the Canadian Government. The work is planned to start at the beginning of June and will continue so long as snow cover remains sparse enough to permit photography of the territory's salient features.

This year's operations continue the Shoran-controlled survey of Canada's northlands which was begun in 1947 by the Canadian Geodetic Survey. During the past ten years all of the country south of its Arctic coastline has been covered by a geodetic net of accurate ground positions established by Shoran method—short-range navigation using V.H.F. and capable of precision measurement giving an accuracy of within 25ft in 100 miles. In addition this year a mapping aid which has been under development by P.S.C. since 1949—the airborne profile recorder, adapting a radar altimeter to elevation and scale control of mapping—will be given initial employment.

This is also the first time a B-17 has been used in such a survey in Canada. It will be supported by a DC-4 (for airlifting personnel and supplies to Foxe Inlet, north of Hudson Bay, where the expedition will be based from May onwards); a DC-3 (to take members of the survey to eight Shoran sites disposed over the 40,000 sq miles of Baffinland that is to be mapped); and a Canso amphibian (to fly out personnel and equipment after the ice break-up, which may occur in June, July or August, making the camp sites accessible only by helicopter).

Flying operations on the survey will be carried out by Kenting Aviation and installation of the airborne Shoran equipment is being done by another Hunting associate, Field Aviation. Photographs taken on the B-17's daily flights—made at heights up to 28,000ft, and spaced at intervals of approximately 20 miles—will be processed at Foxe and inspected by a Government official. From Foxe they will be forwarded frequently to Toronto, for copies on glass plates to be made in the P.S.C. laboratories.

A.C. SYNCHRO MANUAL

THE aviation section of the Radio Communication and Electronic Engineering Association has published a manual entitled *A.C. Synchro Systems for Civil Aircraft*. It gives information for equipment manufacturers, aircraft constructors and operators on the installation and testing of synchro systems in civil aircraft and establishes a code of practice for data transmission between interconnecting systems. The manual describes the possibilities and limitations of synchros, providing circuit diagrams and details on the combination of American and British systems. The Association's offices are at 11 Green Street, Mayfair, London, W.1.

Advanced Aeronautical Education

Points from an R.Ae.S. Discussion at Cranfield

IT was during 1942 that the late G. Geoffrey Smith, at that time managing editor of *Flight*, first ventilated the proposal of training in aeronautical engineering at an advanced level. With far-sighted vision, Sir Stafford Cripps arranged for a committee under Sir Roy Fedden to investigate how such training might be given; and, as a direct result of the Fedden Report, the College of Aeronautics came into being in 1946.

Now, with the College in its eleventh year, it was an appropriate setting for a Royal Aeronautical Society conference on training in advanced aeronautical engineering, and about 140 people assembled at Cranfield for meetings held on Saturday and Sunday, March 23 and 24.

The purpose of the meeting was so that the education committee of the Society might obtain some general views on what was required, and how it might best be effected. The chairman of the education committee acted as chairman throughout all the sessions and gave the final summing-up.

Mr. E. T. Jones, president of the R.Ae.S., opened the programme with a short statement outlining the Society's interest in aeronautical education, and announced that in the near future a full-time education officer would be appointed. In view of the major developments in air transport certain during the next decades, there was a continuing and increasing need for highly trained men in the aircraft industry, and it was essential for the Society to consider closely the syllabus of the many new courses that were now starting.

The first paper was given by Mr. R. L. Lickley, technical director of the Fairey Aviation Co., Ltd., who had formerly been Professor of Aircraft Design at the College of Aeronautics. He spoke on the needs of the aircraft industry, stressing that the standards required were higher than in any other engineering industry. Advanced teaching must be done by those with recent practical experience, and research work should be a major part of their activities. From an analysis of the present intake of trained men, it appeared that industry required each year about 120 men who had received postgraduate training, and it appeared that the two-year course at Cranfield was capable of fulfilling this need.

The next paper was given by Mr. R. A. Mettam, technical training officer of the Royal Aircraft Establishment, Farnborough, and he outlined the requirements of the civil scientific services, with particular reference to the scientific-officer grade. For entrance to this grade, an Honours degree in mathematics, physics or engineering was normally necessary, but there were a few other qualifications which were acceptable, including the Diploma of the College of Aeronautics.

Papers on Sunday morning were presented by Professor A. J. Murphy of the College; Professor A. V. Stephens, Head of the Department of Aeronautical Engineering at Belfast University; and Mr. A. A. Part, of the Ministry of Education. In speaking of the work of the College, Professor Murphy gave detailed information concerning the types of student and their levels when they left. About 40 per cent had degrees, and the majority of the remainder came from the aircraft industry with Higher National Certificates or Higher National Diplomas. Though a higher percentage of graduates obtained first-class diplomas of the College, there was no difference in the figures for second-class diplomas between graduates and H.N.C. men, and no significant difference in the numbers of failures. It appeared that the College was maintaining a high level of entry, and it was successfully giving post-graduate education to those who would otherwise have little opportunity for developing their talents to the fullest extent.

Professor Murphy stated that the College Diploma would in the future be awarded to graduates with degrees in aeronautical engineering who took the second year of the Diploma course. This statement was warmly welcomed by Professor Collar, who felt that aeronautical engineering graduates could gain greatly from a year at Cranfield, particularly if they specialized in Design or Production. Professor Murphy also referred to the possibility of University men taking advantage of the many facilities available at Cranfield while working for post-graduate awards in their universities, and also to the courses in flight testing which were now held for aeronautical students from Imperial College and Queen Mary College. It was to be hoped that other universities having graduate courses in aeronautical engineering would take advantage of these facilities.

Professor Stephens dealt with his experiences in teaching aeronautical engineering at Sydney University for 15 years, and touched on his future work at Belfast. He firmly believed in the advantage to be gained by lectures from industry during courses, and spoke also of the importance of the staff being engaged in aeronautical research.

Mr. A. A. Part referred to some of the difficulties which the College of Aeronautics had encountered in its earlier years. It was hardly surprising that difficulties should have existed in a new kind of educational institution which "had to spring fully sheathed from the ground." Although there was no suggestion that the College had as yet developed its full potential or reached a stage of perfection, yet there was no longer any question concerning its continued existence as the main centre in this country for post-graduate aeronautical education. The Ministry accepted it as such, and hoped that the support which it was receiving from the industry would continue to increase as it had in recent years. Mr. Part referred to the large increases which might be expected during the period 1960-70 in the number of potential university students. This was partly due to the birthrate "bulge," but also to the strong trend for more children to continue at school until the age of 17.

There were many speakers in the discussions which followed the papers, and among the more interesting points which received general approval was the comment made by Sir Victor Goddard that the Services had found that the most useful time to send a man on a course such as that at Cranfield was at the age of 27 to 30. Such men had the maturity of outlook which enabled them to take the fullest advantage of the training given, and it was undoubtedly true that a large percentage of the most successful Cranfield men had been in that age group. Mr. H. H. Gardner stressed the urgent need of men who could work on new projects and referred to the rapidly growing range of new techniques required in the aircraft industry. He felt that the importance of training in management was now more appreciated, and he hoped to see an increase in the facilities available for training in production engineering.

The chairman, Professor A. J. Collar, concluded the meetings by summarizing the various points which had arisen. Some criticism of the Society had been expressed in that it was still not possible for an apprentice to obtain the Higher National Certificate in aeronautical engineering, as could be done with mechanical or electrical engineering. Professor Collar stated that the Council had first formally requested this in 1938 and again in 1946. The matter was continually under review, and it was hoped that there would be a favourable outcome in the near future.

FORTHCOMING EVENTS

Apr. 5. Helicopter Association: "Problems Associated with the Strength Assessment of Rotor Blades," by V. A. B. Rogers, D.C.Ae., A.F.R.Ae.S.
Apr. 5. A.B.A.C.: Annual Dinner.
Apr. 6. British Interplanetary Society: "History of Rocket Development in the Walterwerke," by H. Walder.
Apr. 9. Aviation Forum: Annual General Meeting.
Apr. 9. R.Ae.S.: Section Lecture: "Fail-Safe Structural Design," by N. F. Harpur, Grad.R.Ae.S.
Apr. 13-14. Plymouth Aero Club: Mayflower Air Rally, Roborough.
Apr. 16. R.Ae.S.: Section Lecture: "Simulation Techniques in Aeronautics," by J. J. Foody, Grad.R.Ae.S., and R. A. Paul.
Apr. 17. R.Ae.S.: Graduates and Students Section: "Problems and Prospects in Air Transport," by P. G. Masefield, M.A. (Eng.), F.R.Ae.S.
Apr. 29-May 4. Institute of Metals: Spring Meeting.
Apr. 30. R.Ae.S.: Section Lecture: "Purpose and Problems of Research Aircraft," by F. P. Youens, A.F.R.Ae.S.
May 4. British Interplanetary Society: Film Show.
May 4-5. Aero-Club des Greves du Mont Saint-Michel: Second International Rally, Avranches Aerodrome.
May 9. R.Ae.S.: Main Lecture: First Lanchester Memorial Lecture, by Dr. T. von Karman, Hon.F.R.Ae.S.
May 24-June 2. Paris Aero Show, Le Bourget.
Sept. 2-8. S.B.A.C. Show, Farnborough.

R.Ae.S. Branch Fixtures (to April 24)

Apr. 10, *Christchurch*, Annual Gen. Mtg. and Film Show; *Glasgow*, Annual General Meeting; *Luton*, "Measurement of Aircraft Vibration in Flight," by D. A. Drew. Apr. 11, *Gloucester and Cheltenham*, "Application of Nickel Alloys to Aircraft," by W. F. Featherstone; *Isle of Wight*, Branch Prize Lectures. Apr. 16, *Belfast* Annual General Meeting. Apr. 17, *Coventry*, Annual General Meeting and Film Show; *Preston*, Annual General Meeting and Film Show; *Reading*, Annual General Meeting. Apr. 19, *Brough*, Annual General Meeting. Apr. 24, *London Airport*, "Future Trends in Powerplants," by L. S. Snell; *Gloucester*, Annual General Meeting and Film Show; *Southampton*, "Technical Publications," by Major H. R. Hockley.

To Australia Without Tears

Lessons of a Trip from Croydon to Sydney in a Proctor

Geoff Layton (left) and the author give "Old Gert" her 15-gal overload tank at Croydon.

By RAY OLLIS, D.F.C.

STORIES of long-distance flights in small aircraft are no novelty, but seldom do they contain so much practical information as does this series of notes on a recent 13,000-mile journey in a Percival Proctor 3. The crew consisted of Geoff Layton (owner-pilot), Matt Deen (second pilot) and Ray Ollis (navigator). The last-named, who contributed this article, is an Australian who served in Bomber Command during the war. He is the author of a book "101 Nights," to be published this summer—recalling experiences with a special-duties unit, No. 101 Sqn.

THERE is more to flying half-way round the world than just flying half-way round the world. Bill Reeks, who flew a Proctor to Australia in 1955, told us: "You'll love it. Even when we forced-landed I knew we'd be all right and welcomed the experience." (Reeks was missing for three days in desert south of Bahrein.) But an airline pilot said: "One motor and no radar or radio-compass? You're mad! Even if you don't get lost, the inter-tropical front is 50,000ft high this time of year and it'll smash a wooden Proctor to pieces."

So we approached the Department of Civil Aviation, and found all the facts we wanted, plus plenty of expert advice (and a worried quiz about the extent of our experience).

Preparation included months of writing for visas and diplomatic clearances. Fuel and landing arrangements had to be made for each of our 49 landings. The petrol people seemed more concerned about being paid than being helpful but we finally got a fuel carnet for the whole trip. An export permit was needed for the aircraft. Injections (eight each) were annoying necessities. Overhaul of *Old Gert*, plus essential equipment, cost over £250. Fuel and flying expenses for the trip were to be about another £300.

We left Croydon, on schedule but exhausted, with the following gear: a 19 lb overnight bag each; dinghies and Mae Wests; emergency rations and water; sleeping-bags; medical box; Very pistol; spare wheel, plugs, magneto, filters, oil-seals, fabric and dope; tools and waterproof torch; charts for 13,000 miles; 54 maps, navigation equipment; and—last but most important—extra petrol storage to boost our two twenty-gallon wing-tanks.

Range and Fuel. Our normal range was for 400 miles. This had to be increased to 600, so we fitted an extra 15-gallon tank into a back seat. A hand-pump fed the fuel into the starboard wing-tank. An additional 5-gal tin brought us up to 250 lb overweight. This was not desirable, but the alternative was even less desirable; and we had decided that the safety afforded by extra range, dinghies, etc., more than balanced the dangers of over-loading. We were to learn more about this later.

Another reason for increased fuel capacity was economy. On leaving most countries you can buy tax-free petrol; thus petrol bought inside Italy costs 7s a gallon, but on *leaving* Italy costs only 2s 8d. Between Croydon and Athens all but ten gallons of our fuel was tax-free. (Civil aviation authorities insist that sufficient fuel be carried to reach an alternative field and stand off for forty minutes. This is not only expensive—on long hops in a Proctor it is impossible.) Fuel tax varied from 4s 6d in Italy to 9d in Bangkok, while Kuwait (a better stop than Basra), Cyprus, Bahrein, Sharjah and Singapore were tax-free.

Most airfields do not have 80-octane, so we mixed 100 and 73. In hot weather we ran on 91/98, mixing three of 100 to two of 73. This gave cooler running and used less oil. We supervised all refuelling. Even large airports sometimes supplied fuel in dirty cans (Beirut was one); we found few non-European workers who used filters unless watched; and many tried to charge for more fuel than they supplied (one outfit insisted that it took 23 gallons to top-up a twenty-gallon tank!).

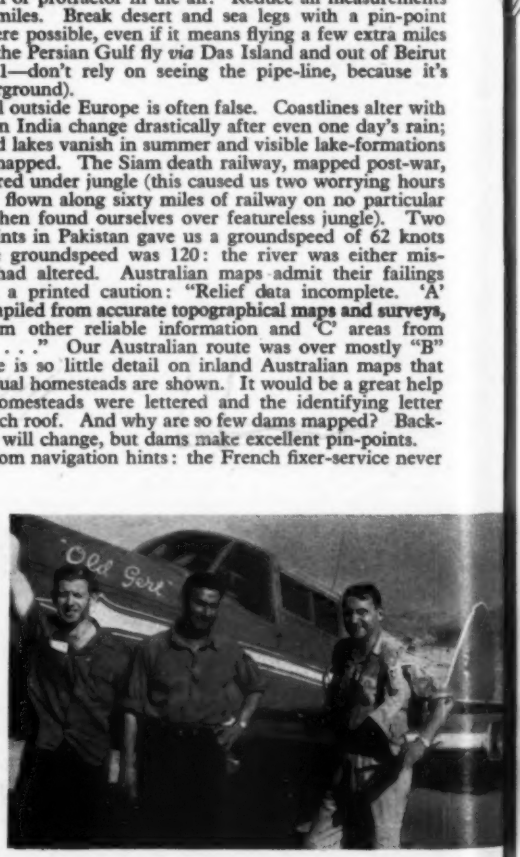
Security. Pre-flight checks are vital. In Rhodes a petrol-cap flew off during take-off, although we had not refuelled. No petrol had been stolen; the "guards" had simply been inquisitive. Even more alarming: in Calcutta our radio and pitch settings were altered. This must have been done just before take-off while people were around the aircraft, because the cabin had been locked in our absence (*do* have locks fitted, by the way).

Navigation. More air-touring accidents occur through getting lost than through mechanical or pilot failure, so I shall discuss navigation next (though with only a compass and a map ours was primitive navigation). First, do all the navigation you can on the ground; compute routes, tracks, distances *before* you take off. Estimate E.T.A.s at good pin-points, and always check. Smoke and wind-lanes are handy wind guides, but don't trust smoke from moving trains, ships, etc. After European maps, Asia's 1/1,000,000 maps and improved visibility will dull your distance-judgment—men have been lost flying what they thought was "just to seaward" of a coastline. Remember: $\frac{1}{10}$-in equals over 1½ miles, and it can take an hour to fly to something you can see. Tie your instruments to your plotting-board; you can't afford to lose pencil or protractor in the air. Reduce all measurements to nautical miles. Break desert and sea legs with a pin-point *en route* where possible, even if it means flying a few extra miles (e.g., across the Persian Gulf fly *via* Das Island and out of Beirut head for T.1—don't rely on seeing the pipe-line, because it's mostly underground).

Map-detail outside Europe is often false. Coastlines alter with tide; rivers in India change drastically after even one day's rain; some mapped lakes vanish in summer and visible lake-formations may not be mapped. The Siam death railway, mapped post-war, has disappeared under jungle (this caused us two worrying hours after we had flown along sixty miles of railway on no particular course and then found ourselves over featureless jungle). Two river pin-points in Pakistan gave us a groundspeed of 62 knots whereas true groundspeed was 120: the river was either mis-mapped or had altered. Australian maps admit their failings frankly with a printed caution: "Relief data incomplete. 'A' areas are compiled from accurate topographical maps and surveys, 'B' areas from other reliable information and 'C' areas from sketches, etc . . ." Our Australian route was over mostly "B" areas. There is so little detail on inland Australian maps that many individual homesteads are shown. It would be a great help if mapped homesteads were lettered and the identifying letter painted on each roof. And why are so few dams mapped? Back-water shapes will change, but dams make excellent pin-points.

Some random navigation hints: the French fixer-service never

(Left) One hand to the pump: Navigator Ollis transfers fuel from over-load tank to starboard wing tank. The five-gallon tin brought the load up to 250 lb overweight.



Well on the way: Ollis, Deen and Layton with the faithful Proctor.

(Left) T.1—vital refuelling stop in thousands of miles of Middle East desert. Soon after the Proctor had passed through—last November—the installation was blown up. (Right) Sixty-hour overhaul at Singapore.

once answered us. On the whole trip we were given only three D/F bearings. Although world-wide air-control is done in English, some accents are hard to understand, some requests are misunderstood and control-equipment may fail (control radio at Ahmedabad was out of order for days, although four radio-mechs were stationed there). Times are all G.M.T., so either pilot or navigator should wear two watches. There is nearly always a towering cloud over Cyprus to home on. Number all maps, fold them in order, and stow them safe from rats and water (rats ate Mt. Everest off our Gaya map). The Kuwait/Bahrein leg looks easy on the map but is misleading; this is where Reeks was lost.

Maintenance. If you can do your own maintenance you will be saved much worry and expense. Norman Waite, who flew a Cessna solo from South Africa to Australia *via* Egypt, India, Malaya, etc., had delays and heavy expenses arising from what finally proved to be a simple fuel-blockage. Many flying clubs will assist you to make your own repairs; indeed, the Bhopal club offers free hospitality and use of workshop and tools to air tourists. Singapore, too, has a helpful flying club. Our 60-hour overhaul there was done in two days for £13 10s—and the club café served a steak-and-egg breakfast before a 6.30 a.m. take-off.

Use a pitot-head cover. McClure reported indicated airspeeds of 70 over Arabia, but our I.A.S. never varied from T.A.S. by more than six knots, and I suspect McClure had sand in his pitot-tube.

As non-mechanical tourists we managed daily service and checks on oil, filters, controls and undercart. We checked tanks for condensation (we had fitted drain cocks, but locals advised us that keeping tanks full prevents condensation) and we always cleaned oil from prop and windscreen. This latter is vital; oil gets very hot in the tropics and weeps through seemingly sound seals, then mists over windscreens. This film of oil catches desert dust and insects, obscuring vision. At Sharjah our Perspex was so clouded we had difficulty in seeing the runway. Our landing here was worrying and very rough. Control told us why: we had landed on a runway under construction, being unable to see the cross that marked its approach. Fortunately we landed with tail down and stick right back, so we suffered only a bumping; had we "wheeled" her on, *Old Gert* might well have pranged. Tighten all aircraft screws periodically; wood shrinks in tropical heat and screws loosen. One check we forgot was our battery: the cells dried and fumes burnt holes in my trousers. Typical that a check one would remember on a car was overlooked in an aircraft!

Finance. Money and language are less trouble than one might expect. All aircrew and air traffic staff speak English, and that helps. Landing-fees are seldom heavy—our highest was 19s, by Aeradio in Sharjah, our lowest "no charge" in Australia. Fuel is signed for on carnet. Always carry some £1 notes (preferably in a money-belt) because travellers' cheques are suspect in India, Burma, Malaya and Indonesia. Indonesian finance is confusing: official exchange-rate is one-third of open market rate, so be sure to arrange Indonesian credits from, say, Singapore. At the correct rate Bali is cheap; at the "official" rate it's expensive. By the way, Indonesian officials can be very trying, but you must be polite or you can end up in gaol and have your aircraft confiscated. Our co-pilot was arrested for merely *carrying* a camera outside "secret" Surabaya airport. Avoid international flying on Sundays: it cost us an extra £8 in Customs overtime, etc., to leave Rangoon for Bangkok on Sunday. Rangoon also charged a "radio fee" on landing. Burma runs Indonesia a close second for this sort of thing.

Local Advice. Get what advice you can from reliable locals. Landing on oiled sand at T.3 we found surprisingly smooth—but when wet it can be treacherous. Always approach Phuket strip from seaward, even if it's down-wind; those hot-sand approaches demand caution, but the wrecks beside the runways will make you careful. Seasons alter cases: we caught the end of the Indian monsoons and the start of monsoons in Malaya and Timor. Fly early over desert; afternoon turbulence between Darwin and Cloncurry could snap a main-spar. Avoid big cloud. Bumpy instrument-flying is harder than you remember.

The Timor Sea. The big leg is Koepang to Darwin—four hours across ocean. For this we decided we needed all the petrol we could lift. We found ten extra one-gallon tins at Singapore and filled them all . . . and only just got off the ground. Until we used some fuel and pumped that extra weight forward of the c. of g., *Old Gert* flew like a broody hen. In hot air, with excess weight, we mushed along, nose up but not climbing, doing 70 on 1850 at minus 3. I estimated that reduced performance wasted three of the extra ten gallons; there is a limit to how much extra weight you can lift. So for the Timor crossing we dumped half our extra cans and stored all weight forward. We took off at 6 a.m. into a forecast headwind. Groundspeed at height across the island was low and we had strong port drift; met. seemed accurate. At sea we still had port drift, but wind-lanes indicated a tail-wind at sea-level. We descended to 1,000ft, estimated decreased drift and flew track as course. We sighted land twenty minutes before original E.T.A. and came slap over Darwin. The leg took 4½ hours and we had 19 gal left.

Decorators were repainting the hotel in Darwin where we called to celebrate. On the walls were signatures of Ross and Keith Smith, Amy Johnson, Kingsford-Smith, Bert Hinkler, Jean Batten . . . and, while we drank, a workman painted them over. He was a young workman and our protests puzzled him—perhaps he had never even heard of Amy Johnson.

From	To	Time hr	min	From	To	Time hr	min
London	Paris	1	32	Gaya	Calcutta	2	08
Paris	Lyons	1	45	Calcutta	Akyab	2	33
Lyons	Cannes	1	51	Akyab	Rangoon	2	34
Cannes	Florence	2	15	Rangoon	Bangkok	3	31
Florence	Rome	1	17	Bangkok	Phuket	3	50
Rome	Naples	1	16	Phuket	Butterworth	2	05
Naples	Brindisi	1	28	Butterworth	Malacca	2	38
Brindisi	Athens	3	04	Malacca	Singapore	1	08
Athens	Rhodes	2	14	Singapore	Djakarta	4	45
Rhodes	Nicosia	2	23	Djakarta	Surabaya	3	36
Nicosia	Beirut	1	31	Surabaya	Bali	1	48
Beirut	T.1	2	46	Bali	Soembawa Besar	1	21
T.1	Baghdad	1	27	S. Besar	Wangapoe	1	55
Baghdad	Kuwait	2	49	Wangapoe	Koepang	1	54
Kuwait	Bahrain	2	12	Koepang	Darwin	4	14
Bahrain	Sharjah	2	46	Darwin	Daly Waters	2	32
Sharjah	Jiwani	2	53	Daly Waters	Cloncurry	4	43
Jiwani	Karachi	2	39	Cloncurry	Longreach	2	46
Karachi	Ahmedabad	3	03	Longreach	Charleville	2	05
Ahmedabad	Bhopal	2	43	Charleville	Bourke	2	04
Bhopal	Allahabad	2	36	Bourke	Parkes	2	00
Allahabad	Gaya	1	58	Parkes	Sydney	1	39

Totals: Distance, 13,000 miles approx.; flying time, 106 hr 19 min.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Thoughts from Two Miles Up

SITTING in warmth and comfort a couple of miles high between Greenland and Hudson Bay has given me an opportunity of reading through your especially interesting issues of February 15 and 22, and particularly the Ensign-class history by Peter W. Moss.

I have always regretted that the Ensigns were broken up when they were, and were not given an opportunity of coming back to civil air transport after the war, when they would still have been well ahead of contemporary types. In a rebuilt form, with four Hercules engines, they could have done excellent service in B.E.A. at a time when the most advanced aircraft available were the much smaller two-engined Vikings. In fact, when I joined B.E.A. early in 1948, I investigated the possibilities of such a rebuilt version, only to find that they had been broken up some months earlier. Even had they cost £100,000 each to convert and modernize, they might well have been cheap at the price. Certainly they would have been giving short-range air transport a four-engined aeroplane, with the attractive high-wing layout, some five years before the Viscount became available. I shall always feel that the post-war revitalized Ensign was one of the great "might-have-beens" of aviation.

I was especially interested also to read your account of the Viscount 802, into which B.E.A. put so much work with Vickers during 1953 and 1954. I believe that the 802 is likely to prove even more successful than the Viscount 700 series, incorporating, as it does, so many developments shown to be desirable from the operation of that historic type.

The third point is the interesting article by Mr. J. M. Ramsden on the medium jet transport.

I believe that there is no doubt that the turboprop will eventually prove to have its most potent place on long-range services, where its unique contributions to economy and range for a given payload at moderate all-up weights, combined with a good runway performance, show to their greatest advantage compared with the pure jet. Although the block speed of the jet can show to advantage over long ranges—so long as the jet can fly them non-stop—the turboprop will offer opportunities for reduced fares which, I believe, cannot remain neglected.

Contrariwise, at the short-range end of the scale, the jet may well turn out to have peculiar advantages in the next generation of aircraft—although, obviously, over short sector distances, the jet's block speed advantage over the turboprop is at a minimum. A short-range jet, however, could be designed with a satisfactory runway performance because it does not have to carry the vast amounts of fuel which so bedevil the long-range jet. The proportionate difference between gross weights of a jet and a turboprop for a given payload is much less on short ranges than long ranges, where the cumulative effect of higher fuel consumption is at its maximum. The short-range jet with a good runway performance can, I believe, come close to the equivalent turboprop in economic performance because, while its all-up weight for a given payload is closely comparable, its revenue-earning payload is likely to be higher than the turboprop on account of enhanced speed.

Thus, rather contrary to Lord Douglas' conclusions, I believe that once experience has been gained of the more sophisticated turboprop and jet aircraft of the future, there will be a substantial demand for both the long-range turboprop and the short-range jet on grounds of economy and of operational characteristics.

A final point concerns a very different type of aircraft which has recently been discussed in your Correspondence columns—the Chipmunk. We at Bristol recently obtained an ex-R.A.F. Chipmunk and, without more than a modest expenditure, were able to get the modifications completed to a civil standard—including 24 gallons of fuel. The Chipmunk in civil form is certainly the most attractive small aeroplane flying in this country today, marred only by inadequate baggage capacity when flying with two up. I would also like still more range, and we are currently looking into the possibilities of adding additional fuel capacity.

Over these Arctic wastes Chipmunk flying seems rather far removed, but the qualities of the long-range turboprop very much to the fore.

Vancouver, B.C. PETER G. MASEFIELD.

[Mr. Masefield, managing director of Bristol Aircraft, Ltd., wrote this letter to us during his recent trip to North America in Britannia G-AOVA—Ed.]

Dakota KN550—subject of the letter below—as it was in 1949. Rebuilt by Eagle Aircraft Services, it is now flying with Aden Airways.

A Dakota's Past

THE article "Cinderella Transformation" in the March 15 issue of *Flight* struck a chord in my memory, Dakota KN550 having been one of "B" Flight's aircraft at Lübeck during the Berlin Airlift. The enclosed photograph shows the aircraft taxi-ing out *en route* for Berlin some time during April 1949.

Checking my snag diary I find that 550 suffered very little unserviceability beyond slight oil leaks and was in constant service to and from Berlin, Lübeck, during my time with "B" Flight, February to July, 1949.

R.A.F., Feltwell, Norfolk. L. TOWNEND, Sgt.

Mozart and Exports

(From Mr. Julian Snow, M.P.)

MEMBERS of Parliament of any experience are fully conscious of the dangers of employing "irony" in their speeches. Such speeches are usually misunderstood and react unfavourably to the speaker in question. This can arise in the printed word.

Your editorial of March 15 ("Gracious Voyaging," with cross-heading "The Menace of Mozart") witty and ironical though it was, has caused some resentment in French official and industrial circles. The writer has had difficulty in explaining that the use of such phrases as "catchpenny commercialism," "the reactionary French," and "decadent Frenchmen" can be understood as being inoffensive only if one has a somewhat sophisticated and complete understanding of the English sense of humour. In view of the substantial Continental circulation of *Flight*, is it wise to work on the assumption that all your Continental readers possess this degree of sophistication and understanding?

Surely most sensible people would acknowledge the need for encouraging any method of reducing the tedium of air travel, and it was the French, for instance, who inspired the amenities of the Golden Arrow train service when it was initiated before the war.

Whereas I was able to appreciate what was an erudite piece of writing, we must all remember that it would be maladroit to jeopardize the goodwill of the French Government and others who at the present time are buying valuable amounts of British aircraft and aircraft components.

House of Commons. JULIAN SNOW.

WE have looked into your last issue of March 15 and we feel obliged to express our amazement at the second part of your editorial—"The Menace of Mozart." It is obvious that the author cannot understand neither Mozart, nor Corot, nor international comity, nor perhaps, alas, anything!

Furthermore, this article contains some scandalous stupidities which it would be childish to give a full list of. For instance, we did not know that being enraptured by Mozart or Corot could be a sign of "retrogression of taste and selfish preoccupation with mere animal comfort." Another nonsense: what exactly do you mean by "gracious living at present offered at such personal sacrifice on the part of airline operators"? Is "gracious living" bad taste?

Actually, you give the Caravelle the poisonous bite of jealousy.

St. Etienne, Loire. J. DRIOL.
Le Pontet, Vancluse. B. VANEL.

[We applaud Mr. Julian Snow's concern for Anglo-French relations, and we admire the spirit of our two French correspondents. Though the opinion of these last-named gentlemen, that we fail to "understand" either Mozart or Corot, is doubtless a just one, it in no wise diminishes our reverence for those immortals; and that same reverence extends no less to Molière, whose precious irony has enriched the world in no less degree than Mozart's sonatas and Corot's landscapes. But irony, as Mr. Snow so shrewdly remarks, may itself be "misunderstood"; and misunderstanding being something to obviate at all events, we protest in all earnestness:

(1) That our editorial was written in *acclaim* of the Caravelle—not in derision.
(2) That the characteristics and qualities of this aeroplane have been set forth more exhaustively in this journal than in any other—irrespective of nationality.
(3) That the "bite of jealousy" was nothing more venomous than a congratulatory handshake.

Oh, the irony! ED.]

CORRESPONDENCE . . .

Blinding with Science

ALTHOUGH I do not presume to be any sort of scientist I always fondly believed that I knew most of the more well-known words which scientists use. Sir George Edwards' diverting little ditty which you published recently [March 22, p. 357—Ed.] speaks of "megatrons" and "clystons". Now I have come across magnetrons and klystrons often enough, and I also fear the prospect of nuclear weapons with a megaton yield; but what are these new devices they are cooking up at Weybridge?

London, W.C.1. LEXICOGRAPHER.

All-through Jet Training

(*From S/L. Holt, A.F.C., R.A.F., Retd.*)

I HAVE read several comments, including one from Messrs. Hunting Percival, on my letter of February 15, in which I suggested that the introduction of all-through jet training of pilots in the R.A.F. would cost more than the propeller/jet sequence of training. Nothing I have read has changed my point of view.

I would first assure Messrs. Hunting Percival that I am not criticizing the Jet Provost as such; indeed, I think its introduction will effect some economy by reducing the training period on the more expensive Vampire trainer.

What I do say is that it is uneconomic to give a pupil pilot his *ab initio* training on an expensive jet aircraft. I think he should have at least 50 hours' training on a simple, inexpensive propeller aircraft at one-fifth (or even less) the cost of the Jet Provost.

In this initial 50 hours' flying, not only would he learn the elementary process of controlling and navigating the aircraft, but he would also acquire the basic airmanship, discipline and experience of the weather in the lower levels of the atmosphere. Furthermore, this 50 hours' inexpensive training would eliminate at least two-thirds of the unsuitable pupils.

I am not at all convinced by the argument that this training would be valueless, that he would acquire bad propeller-aircraft habits or outdated technique which would hinder his progress on jet aircraft.

Herne Bay, Kent. FRANK HOLT.

[Invited to comment on this further letter, Hunting Percival Aircraft, Ltd., make the remarks given below:—

"All the evidence goes to show that initial training on simple propeller aircraft does *not* prevent excessive wastage in the later training stages where it becomes so expensive.

"Approximately one-third of the pupils so far trained on the Jet Provost have previous flying experience. The opinion of the flying instructors concerned seems to be that this, far from assisting their training, constitutes a hindrance. This is not theory but expert opinion based on practical experience.

"The use of a third training type is extremely wasteful in spares provisioning, special tools and equipment and the technical training of maintenance personnel.

"Your correspondent appears to ignore the indisputable fact that 50 hours' flying in the Jet Provost provides a pupil who is infinitely superior in every respect to one who has a similar amount of propeller flying."]

THE INDUSTRY

Napier's Luton Prizegiving

SPEAKING at the annual presentation of indentures and awards to apprentices at D. Napier and Son's Flight Development Establishment, Luton, Beds, Mr. R. P. Yule, apprentice supervisor, said that the standard of boys leaving the local county secondary modern school was improving. However, of the 135 who had applied for Napier apprenticeships, they had been able to accept only 16. "We are sorry to have to refuse so many good chaps," he added.

Mr. W. F. Crewdson, technical personnel and education officer, explained that the firm's student apprentices were working on a sandwich basis of six months' practical training in the works and six months in the college of further education.

Apprentices who had completed their training were presented with their indentures by Mr. R. C. Marcell, the assistant manager, who also presented merit certificates and special prizes, deputizing for Mr. C. L. Cowdrey, the general manager, who was unable to be there because of illness.

The guest speaker was Mr. W. E. Park, formerly education officer of Vauxhall Motors, Ltd., Luton. He recalled the days of his youth and spoke of the progress made in apprenticeship schemes over the years. He said the apprentice of today got every opportunity to make the best of himself. He was sure that 30 years ago industry did not get the high standard from apprentices that was achieved nowadays.

Merit awards were presented by Mr. J. R. Ridgeway, the works manager, and the company's trophy by Mr. Park. This went to Clive Bandy, who joined as a craft apprentice and was up-graded to student at the end of his third year. His apprenticeship had been extended by one year (making six in all), to enable him to take further works technical training. The runner-up prize went to John Cripps. Mr. E. G. Brook, chief plant engineer, presented awards for the best exhibits in the hobbies display.

The prize presentation, which took place in the staff canteen on March 6, was attended by more than 260 parents and guests, with representatives of local education authorities, and by about 78 apprentices.

Administration in Comfort

WELL known for many years past in the aircraft industry (and in numerous others) as makers of "Bostik" sealants and adhesives, the B.B. Chemical Co., Ltd., of Leicester, have recently moved their offices into a new administrative building. Of modern design and attractive appearance, the structure has large double-glazed windows which provide temperature control as well as efficient lighting.

The new building was formally opened on March 25 by Mr. C. Bennion, chairman of the British Shoe Machinery Co., Ltd. (The shoe trade use B.B. Chemical products extensively; it was in this field that the company, under their original title of the Boston Blacking Co., first started supplying their products some 55 years ago.)

Rubber Cord Standards

TWO revised British Standards have been issued specifying the construction, quality, mechanical properties, identification and testing of heavy- and light-duty braided rubber cord.

The heavy-duty cord (to which B.S.6F.16 : 1957 refers) is suitable, when cut up into unit lengths, for the manufacture of shock-absorber cord assemblies and for other aircraft purposes. Eight sizes of these cords are specified, in diameters ranging from $\frac{1}{16}$in to $\frac{7}{16}$in. The light-duty cords (B.S.4F.51 : 1957) are used for parachute opening devices, light-weight suspensions and other aircraft purposes; in this weight four sizes of cord are specified in diameters from $\frac{1}{16}$in to $\frac{1}{4}$in.

Copies of these standards are available from the B.S.I. Sales Branch, 2 Park Street, London, W.1, price 2s each.

Silicone Rubber Development

A NEW fluorinated silicone rubber which is said to retain its elasticity over a temperature range from −60 deg C to 200 deg C and to resist attack by aircraft fuels, hydraulic fluids and petrol-based engine oils was demonstrated for the first time in this country on March 27, during the International Synthetic Rubber Symposium. The demonstration consisted of immersion of various O-rings in a paraffin bath; whereas rings made of con-

A score of students and staff members of the Imperial Defence College recently visited the Handley Page works at Radlett to study techniques in the design and production of high-performance military aircraft. In this group are (l. to r.) A. Cdre. R. F. M. Green, R.A.A.F.; Captain C. P. Coke, R.N.; Mr. R. S. Stafford, director of Handley Page's technical department; Rear-Admiral W. G. Crawford; and Mr. G. H. Lee, deputy chief designer. They are inspecting test equipment.

THE INDUSTRY . . .

ventional silicone rubber exhibited swelling, those made of the new material retained their dimensional character.

This solvent-resistant silicone rubber, Silastic LS-53, is now available from Midland Silicones, Ltd., 19 Upper Brook Street, London, W.1; it was developed by the company's American associates, Dow Corning Corporation, in conjunction with the materials laboratory of the Wright Air Development Center.

Before the demonstration, Mr. P. C. Servais (of the Dow Corning Corporation) and Dr. Ivor Riley, manager of the silicone rubber section of Midland Silicones' technical service department, presented a joint paper on recent developments in silicone rubber.

The Graviner-Fenwal Agreement

AS briefly recorded last week, an agreement involving broad cross-licensing of patents as well as a full interchange of technical and manufacturing information has been entered into by the Graviner Manufacturing Co., Ltd., and Fenwal Inc., of Ashland, Mass. Under this agreement the two firms permit each other to manufacture and sell their proprietary products within their respective marketing areas. Graviner products, as is well known, include fire detection systems (including "Firewire"), automatic high-rate discharge bottles, inertia and crash switches, and explosion-protection equipment.

In the U.S., Fenwal have for a number of years been a major supplier of fire-and-overheat detectors and temperature controls to the aviation industry. Among their best-known products are several hundred models of thermostats and overheat detectors based on their patented Thermoswitch differential-expansion principle; jet engine thermocouples and harnesses; and thermistor-actuated temperature controllers.

The agreement also calls for full interchange of design, technical and manufacturing information, except for equipment covered by security regulations.

As an immediate consequence of the new arrangement, Graviner will become a domestic source of supply for Fenwal equipment to British and other airlines which operate American-built aircraft, the majority of which carry Fenwal detectors of some type. Similarly, Fenwal will be able to furnish U.S. airlines with Graviner equipment for British-built aircraft, such as the Viscounts now being operated in the U.S. and Canada.

Plessey Nucleonics Appointment

The Plessey Co., Ltd., announce that Dr. Denis Taylor, Ph.D., M.Sc., B.Sc., Head of the Electronics and Instrument Division at the Atomic Energy Research Establishment, Harwell, has been appointed a director and general manager of Plessey Nucleonics, Ltd. In addition he will become research executive of the Plessey aircraft and electronics group and will be responsible for the co-ordination of the company's nuclear programme. Recognized today as one of the world's leading authorities on nuclear instrumentation, Dr. Taylor was engaged during and after the war on radar development work.

Mr. A. J. Brant

WE regret to record that Mr. Albert J. Brant, A.F.R.Ae.S., M.S.L.A.E., who for many years was service manager of the de Havilland Aircraft Co., Ltd., and who retired at the end of April 1956, died on March 24, following a sudden illness. He was 62 years old.

Mr. Brant was an original member of the staff of the company when it was formed at Stag Lane Aerodrome in 1920, and previously had for six years been one of the de Havilland team at the Aircraft Manufacturing Co., Ltd., Hendon. He leaves a widow and a married daughter.

Helicopter Sales Directorship

THE managing director of Helicopter Sales, Ltd., Kings Langley, Herts, announces that Mr. I. A. F. Donnelly, who has been acting as general manager of the company since April 1956, is now appointed an alternate director.

Mr. Donnelly, a mechanical engineer who served with the R.A.F., was formerly engaged in the development and marketing of electro-mechanical appliances. He was the first pupil to obtain a helicopter rating endorsement on the initial course of helicopter training at Air Service Training, Ltd., Hamble, to whom Helicopter Sales, Ltd., had previously supplied Hiller 12Bs.

Mr. I. A. F. Donnelly (see "Helicopter Sales Directorship").

Helicopter Sales state that they have been responsible for helicopter orders exceeding half a million pounds in gross value. Westland, Sikorsky and Hiller aircraft sold by them have been operating in New Guinea, Borneo, Pakistan, Sudan, Switzerland, South Africa, Ceylon, Persian Gulf, Nigeria, British Cameroons, Jamaica and Yugoslavia.

IN BRIEF

Tecalemit, Ltd., announce that as a result of the demand for their new range of standard air compressors they have decided to concentrate on the production of this equipment and to discontinue manufacture of the earlier type.

* * *

Ransome and Marles Bearing Co., Ltd., wish to stress that the telephone number of their branch office in St. Paul's House, St. Paul's Street, Leeds, is 32094/5 and not—as formerly when they were in Norwich Union Buildings—27133.

* * *

In last week's description of the Rollason mobile de-icing plant it should have been made clear that the particular equipment illustrated was that developed for the M.o.S.

* * *

Three new floor-cleaning machines, powered by Exide traction batteries, have been introduced by Diamond Motors (Wolverhampton), Ltd., Upper Villiers Street, Wolverhampton. The machines—known as the Mechocleen range—are a dry scrubber/polisher, a wet/dry scrubber/polisher, and a dryer.

* * *

From Claude Lyons, Ltd., Stabilizer Division, Ware Road, Hoddesdon, Herts, comes a leaflet describing their automatic tap changer, designed to overcome the difficulties commonly associated with mains-supply fluctuations in electronic equipment. Operated by an electronic senser unit, the Claude Lyons A.T.C. is stated to keep its output voltage within ± 5 per cent of the declared value, even with input fluctuations as great as −20 per cent to +10 per cent.

* * *

Teddington Aircraft Controls, Ltd., have closed their London office at 51 Brompton Road, Knightsbridge, S.W.3. The technical liaison staff has transferred to the company's Reading office at Cheapside Chambers, Cheapside, Reading, Berks (tel. Reading 3074). Another change in location is that as from the end of March the advertising department was due to be moved from Hounslow to the company's Merthyr Tydfil factory, where it will be under the control of Mr. F. C. Batten, the publications manager.

The "Talurit" safety sling consists of a steel rope strop on which are threaded rectangular rubber pads designed both to provide a non-slip grip and to prevent damage to the article being hoisted. The makers are Cable Covers, Ltd., "Talurit" Division, St. Stephen's House, Westminster, London, S.W.1.

A "Flight" photograph of Napier's Scorpion Canberra, with the rocket motor seen firing.

TEN THOUSAND TEST FLIGHTS

The Story of a Napier Development Establishment

AT the close of 1956 the Napier Eland-Convair landed at Cranfield after a routine flight, and the 10,000th test flight to have been flown by the Napier Flight Development Establishment at Luton was completed. The total itself illustrates the tremendous amount of research and flight development carried out at the Establishment since it was formed in March 1940.

A cluster of wooden huts and a single hangar made up the Establishment in those days; but since then it has grown into a self-contained unit, having some of the finest rocket, ramjet and flight-testing equipment in the country. In 1940 seventeen men and one Fairey Battle aircraft, fitted with a prototype Napier Sabre engine, made up the staff and the job on hand at Luton when test flight number one was flown. Soon afterwards a second Battle arrived for conversion to take a Sabre. Meanwhile building was in progress and new hangars, an office block and workshops were soon completed.

Development flying of the prototype Sabre installation in the Battle continued throughout 1940, and in May of the same year a Handley Page Hereford, fitted with two Napier Dagger engines, was received for development work on the oil and air-cooling systems. Several Herefords were subsequently modified at Luton as a result of these developments. The second Sabre/Battle was completed in March 1941, and was handed over to the R.A.E.. In all, the Sabre/Battles flew over 700 hr before completing their development rôle.

One of the most notable achievements in the years 1940-42 was the design and production of the Sabre power unit for the Blackburn Firebrand. This was the first of the detachable "powerplants" to be produced in this country. Various one-off Sabre power units were also designed for the single-engined Folland flying test bed. The Folland was specially designed for aero-engine and powerplant flight-testing, and three such aircraft completed nearly 500 hr in the course of Sabre installation development.

In September 1941, flight testing of the first of the Sabre-engined Hawker Typhoons was started, and for the next three years their development was the principal activity. At one period there were sixteen aircraft at Luton for development work on Sabre II, III, IV and V engines, including two Blackburn Firebrands. There were many problems in these new engine/airframe combinations, but with the background of war in which air supremacy was recognised as a matter of existence, answers had to be found quickly.

It was while the Normandy fighting was at its height that the Luton Establishment was called on for a supreme effort as dust and grit from the Normandy air strips grounded the Typhoons because of excessive engine wear. An efficient air cleaner was urgently required, and eight hours after the notification a prototype had been designed, built, installed and test flown. After a further test in Normandy production was started and, only thirteen days after the original call, all Typhoons in France were equipped with the new air cleaner and operations were resumed in full strength. Later tests made by the R.A.E. at Farnborough showed that the cleaner had an efficiency of 92%.

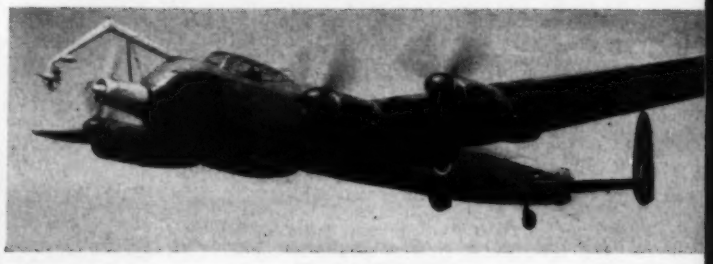
As the war drew on, work at the Establishment shifted from the Typhoon to the Tempest. Considerable development was devoted to various radiator and oil cooler installations and the proving of them in flight. This work culminated in the annular radiator, which was followed by the ducted spinner/annular radiator combination flight-tested in a Tempest. The results of these tests showed that both types of installation were practical and of sound conception.

During this period, a Vickers-Armstrongs Warwick was fitted with 3,000 h.p. Sabre powerplants incorporating annular radiators and cooling fans. This aircraft was modified with a view to civil applications and was shown at the 1946 S.B.A.C. Display.

Two years later Napier exhibited the prototype of the Naiad turboprop at the Display. This was the first of the Napier gas turbines and was designed to give 1,500 e.h.p. The flight-testing of the engine was carried out with the unit mounted in the nose of an Avro Lincoln; a second Lincoln was later modified for icing trials on the Naiad air intake and propeller spinner. In this conversion a dummy Naiad engine was installed in the nose of the aircraft and a spray-head fitted to produce icing conditions.

At about this time the Establishment undertook the construction of a flying test-bed for the Bristol Aeroplane Company. This entailed the installation of a Bristol Phoebus turbojet in the bomb bay of a Lincoln aircraft. In 1948, a Fairey Spearfish was modified to carry out research on water-spray nozzles for later use on artificial ice-producing equipment.

This period saw the beginning of a great deal of research work on electro-thermal methods of de-icing aircraft and a contract was



The Sabre-powered Fairey Battle (right) was the first machine to be tested at Napier's Luton establishment. Below is one of three Sabre-engined Folland flying test-beds, with a powerplant similar to that installed in the Blackburn Firebrand. In the air is the Avro Lincoln, equipped for Naiad intake-icing research trials.

Immediately above is a little-known Napier installation—that of a Bristol Phoebus in an Avro Lincoln. The Fairey Spearfish (upper right) was modified for water-spray nozzle development in respect of icing research projects. The Vickers Viking was employed on basic research into electro-thermal and hot-gas ice protection systems.

TEN THOUSAND TEST FLIGHTS . . .

received from the Ministry of Supply for the modification of a Vickers Viking for this work. The Viking was fitted out with a miniature power station driven by a Gipsy Queen II engine for supplying electrical power for experimental heater mats under test on the fin of the aircraft. Water-spray equipment for the simulation of icing conditions and droplet-sampling apparatus was installed on the top of the fuselage.

The years 1950 and 1951 saw a period of expansion and the beginning of the company's research on liquid-propellant rocket engines and ramjets. However, in spite of changes in both the geography of the Establishment and the character of its work, it remained faithful to its original rôle, and in 1951 work was started on the installation of the prototype Nomad engine. For flight testing this engine was also installed in the nose of an Avro Lincoln and a period of flight development was duly completed.

It was in 1952 that the Eland turboprop made its debut at the Establishment. A Vickers Varsity was modified for use as a test-bed, and the first flight of an Eland took place in the summer of 1954. A point of particular interest was that the aircraft initially had an Eland fitted in the starboard nacelle only, the original Hercules engine being retained on the port side. It is believed that this was the first aircraft to have flown in this country with asymmetric engine layout—not counting some of the ingenious and sometimes desperate engine arrangements adopted during the war to fly aircraft to repair bases.

Within the first 10 hr of its flying life the Eland had been successfully operated at altitudes up to 30,000ft and had actually been re-started in flight at 25,000ft—believed at that time to be the highest altitude at which this had ever been accomplished with a turboprop. It was in the Varsity that the Eland was first shown to the public—at the S.B.A.C. show at Farnborough in 1954. The aircraft had by then been fitted with two Elands.

In order to carry out route proving trials, a B.E.A. Elizabethan was fitted with Elands and became known as the "New Elizabethan." This aircraft played an important rôle in the flight-development of the Eland and subsequently appeared at the 1955 S.B.A.C. Display.

Late in 1954, a Convair 340 airliner was purchased in America and was flown across the Atlantic to the Establishment. Fitted with Elands, the Convair became a first-class example of what British turbine engines can do for an American airframe (i.e., lower operating costs, greater speed and longer range). A full demonstration programme is scheduled for this aircraft in the future. In all, the three aircraft testing the Elands have flown a total of 764 hr.

During 1955 a Canberra was extensively modified for the English Electric Company and became the prototype high-altitude P.R.9. It was fitted with new Avon turbojets of a higher thrust and the wing planform was modified for operation at extremely high altitudes. At the same time the Establishment was also busy working on an Avro Ashton. This machine was fitted with an engine pod beneath the fuselage which could be rapidly adapted to take different types of turbojet. The purpose of the conversion was to provide a flying test-bed capable of attaining high altitudes. The first engine to be installed was a Rolls-Royce Conway by-pass turbojet, and this was the first Conway in any aircraft.

Although the Viking gave excellent service for seven years and accumulated a great deal of valuable icing research data, it was placed on the retired list in 1955, and the Lincoln originally used for Naiad engine icing tests was re-converted for aerofoil de-icing trials. With its higher operating altitudes and ample forward speed the Lincoln greatly increased the scope of icing investigations. The first programme completed by this aircraft consisted of tests to prove the efficiency of the aerofoil hot-air anti-icing system as fitted to the Blackburn Beverley. These trials proved successful and the aircraft is now being converted yet again for a further series of tests on an aerofoil section representative of the wing and tail surfaces of an unspecified transport aircraft.

In 1956 the Napier Scorpion liquid-propellant rocket engine was flight-tested in a modified Canberra and was later demonstrated to the public at the S.B.A.C. Exhibition. The Scorpion Canberra is at present undertaking an extensive flight-test programme over a wide range of altitudes and conditions.

Since the early days when flight-testing was the only major operation, the Establishment has developed into a miniature Royal Aircraft Establishment, covering more than 70 acres and employing more than 1,200 people. Comprehensive equipment has been installed to enable all branches of aeronautical propulsion and their associated problems to be investigated. Included in this category are some of the most modern and complete rocket and ramjet testing facilities in the country, including a 100g centrifuge designed and built by the Establishment. Details of this centrifuge are likely to be released shortly. In order to further the development of Napier power units a special test tower has been built on which the operation of a complete engine installation can be investigated and the control system thoroughly checked in conjunction with the helicopter rotors for which the power unit has been designed. Spraymat—the trade-name for the Napier electro-thermal de-icing system—has been exclusively developed and manufactured at the Establishment and now forms a very large part of its commitments. Flight-development of the Eland and the Scorpion steadily continues, together with flight proving trials of various ice-protection systems. Several new flying test-beds for the Ministry of Supply and for various aero-engine manufacturers are now under conversion in the Napier workshops and hangars (including a Gloster Javelin with two reheat de Havilland Gyron Juniors).

Thus 10,000 flights have taken the Flight Development Establishment from the ultimate in piston-engine development, through the field of commercial turboprops to the age of rocket-powered aircraft.

"Flight" photograph

High hopes are entertained for the Convair 340 powered with Eland turboprops. Napier's demonstrator is seen.

CIVIL AVIATION

The second production Lockheed L.1649A is seen here flying from Burbank in the colours of its first purchaser, T.W.A. The airline has given this fine piston-engined transport the ticket-selling tag "Jetstream Starliner."

DC-6As FOR HUNTING-CLAN

HUNTING-CLAN announce that they have placed an order with Douglas for two DC-6As, to be delivered in August and September 1958. The aircraft, say Hunting-Clan, are primarily intended to replace Yorks at present employed on the Africargo air freight service to Africa. They point out that no British aircraft of the right size are available for their Africargo needs over the next three years.

The DC-6As, which will cost Hunting-Clan about £1.2m with spares, are capable of carrying payloads of nearly 29,000 lb of cargo. They can be used for passenger work also, although Hunting-Clan's opportunities for employing the aircraft in this manner at present appear to be slight. The company's two new Viscount 759s, recently the subject of so much colonial-coach controversy, have been sold to Icelandair.

COMET 3 PROGRAMME

THE de Havilland Comet 3 prototype, recently brought up as closely as possible to 4 and 4A standard for certification flying, has completed in its first month of flying 32 sorties averaging 1½ hr each. This intensive programme included general performance testing, measured take-offs and examination of air-intake behaviour. Performance tests in tropical conditions are due to be undertaken in the near future.

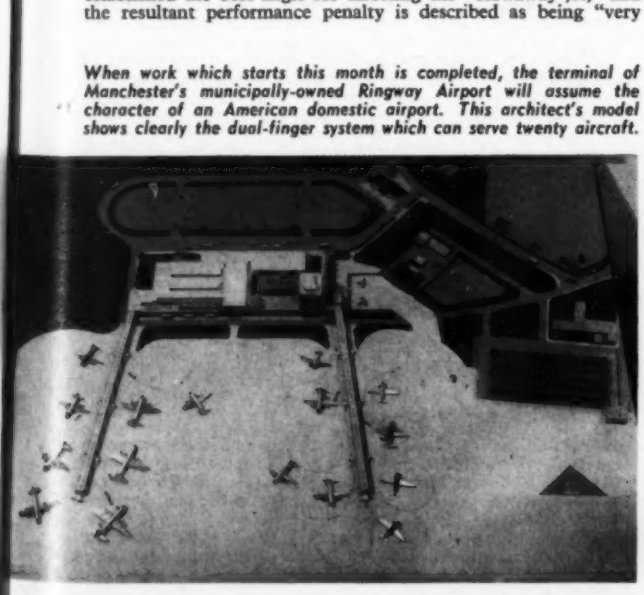
"BLOWAWAY JET"

ON page 459 we note that nearly half the U.S.A.F.'s recorded jet engine failures have resulted from the ingestion of runway dirt—stones, nuts, bolts and so forth. This was one of the problems discussed at the recent I.C.A.O. symposium in Montreal.

From Douglas comes news of an ingenious invention designed to protect the DC-8's power units from this hazard. Called by Douglas "the blowaway jet," the device works on the aerodynamic principle that a suitably-directed jet of air prevents the formation of the vortex responsible for the sucking in of foreign materials. Experiments with a small jet of air bled from the compressor established the best angle for directing the "blowaway jet," and the resultant performance penalty is described as being "very small." Douglas say that the principle appears to provide a fundamental method of dissipating any vortex—even small tornadoes.

The engineer responsible, Mr. Harold Klein, says that intake screens involve performance penalties, and introduce icing and structural problems of their own. This concurs with Mr. Jack Dyment's views on the subject, recorded last week.

When work which starts this month is completed, the terminal of Manchester's municipally-owned Ringway Airport will assume the character of an American domestic airport. This architect's model shows clearly the dual-finger system which can serve twenty aircraft.



B.O.A.C. CO-OPERATION WITH TURKEY

CLOSER co-operation between B.O.A.C. and the Turkish airline Turk Hava Yollari will be the outcome of recent talks in London between the Turkish Minister of Communications, Mr. Arif Demirer, and the chairman of B.O.A.C., Mr. Gerard d'Erlanger. B.O.A.C. has, incidentally, been using Istanbul regularly during the recent Middle East crisis.

MILES PLAN TRANSPORT ACTIVITIES

AS indicated in an Air Transport Advisory Council public announcement last week, F. G. Miles, Ltd., of Shoreham Airport are planning to enter the air-transport business. They have applied to the Council for a permit to operate summer-season scheduled services with Herons and Marathons between Shoreham and Dieppe, starting this year. Other operations which are included in the plans are summer services from Shoreham to Le Touquet, to Jersey (*via* Guernsey), and to Paris.

It is understood that the company's long-term plans include the possible use of the H.D.M. 106, the joint Miles Hurel-Dubois transport venture of which a development prototype, the 105, is due to fly in the near future.

A VOICE FOR THE PASSENGER

USUALLY, when a member of the public does not like a commodity for which he has paid good money, he complains to the supplier or transfers his custom elsewhere. In this simple manner are acceptable standards of price and service maintained in commerce.

It is unusual for a section of the commodity-consuming community to form an association—with membership fees—to protect its interests; but this is what has now taken place among the "consumers" of the air transport industry.

An association to be known as The International Society of Air Travellers and Air Transport Users was inaugurated in London on March 27, with Lord Brabazon as its president. The objects are ninefold: (1) to care for the interests, safety, comfort and convenience of air travellers and air transport users; (2) to help in improving the volume, scope, regularity, usefulness and safety of air services; (3) the abolition of all unnecessary delays and restrictions on air travel and transport; (4) the abrogation of vexatious international and national legislation; (5) to represent the views of passengers and users; (6) to extend the *camaraderie* among air travellers; (7) to popularize air travel and air transport; (8) to support beneficial developments in civil aviation; and (9) to promote international understanding through air travel.

At the inaugural meeting it was established that the new Society has not been formed in a spirit of criticism: complaints against unexplained delays, accommodation and so forth will form only a part of the activities. The society has been founded by Mr. Cecil Turner, a London advertising agent. The twelve-strong inaugural committee are, so far as air transport is concerned, all lay members of the public, with the exception of Mr. H. R. Gillman, secretary-general of the F.A.I. He has invited aero clubs in 48 countries to help in furthering the aims of the Society abroad.

CIVIL AVIATION . . .

THE FUTURE OF LONDON AIRPORT

THE growth and development of London Airport have recently been the subject of two papers by men who have lived close to L.A.P. since the war. In our November 16, 1956, issue, we summarized the paper read before the Royal Aeronautical Society by Sir John D'Albiac (who, until he retired earlier this year, was Commandant). Now Sir Alfred Le Maitre, Controller of Ground Services, M.T.C.A., has made a contribution in a paper read before the Royal Society of Arts on March 27. Although Sir Alfred did not refer to recent reports that "vast replanning of London Airport may soon be needed" because of Government "miscalculations" of future traffic growth, he did say: "Few big projects end up as planned, and London Airport is no exception. Aircraft grow larger and are more densely seated, so that turn-round times and therefore stand-occupancy on the apron grow longer. Consequently, round the diamond we are growing short of apron space. Moreover, I think we must accept that the early plans under-estimated the parking problem . . . In addition, the use of outer stands involving a bus journey from terminal to aircraft, though logical, has never been popular with the public or the operator."

To increase apron space and because present runway capacity should be sufficient, it was now possible, Sir Alfred said, that one—or possibly two—runways would be put out of commission. The next step was to bring into the central area the long-haul international operations at present at L.A.P. North, with resultant opportunities for experiments with the finger system.

Inside a Britannia at Belfast representatives of Northeast Airlines are seen discussing contractual matters with (right) Mr. E. J. Stevens of Shorts. The Northeast engineers are, from left to right, Messrs. Meiss, Case and Splaine, the last-named being the representative at Bristol.

THE MEDIUM-TRANSPORT COST CONTROVERSY

THE interesting article by Mr. F. H. Robertson in *Flight* of March 8 ("The Medium-range Transport") presents a clear-cut conclusion. This is always a happy state of affairs if it really is so, but one must regretfully come to the conclusion that the answer is not so clearly in favour of the turboprop as he has presented it. Furthermore, this can be shown by studying the figures in his article.

Firstly, in respect of the simplified cost formula, there is much to be said for the cautious use of such a labour-saving device. To be simple it must leave out account of many factors, but those which are included should be realistically assessed. Accepting the fact that crew costs and landing fees cannot easily be included, some of the assumptions which are used to arrive at the numerical coefficients are not in line with European operating experience; these are set out in Table 1:—

TABLE 1

	Robertson	More realistic
First cost of aircraft	£9/lb	£14/lb
Spares cost	Nil	30% of first cost
Annual utilization	3,000 hr	2,250 hr
Fuel cost	24d/gal	20d/gal

The effect of using the more realistic figures is to alter the formula direct operating cost from:—

$$1{,}000\,\frac{W}{VP} + 10{,}000\,\frac{F}{PR} \text{ pence/long-ton n.ml.}$$

to:—

$$1{,}780\,\frac{W}{VP} + 8{,}400\,\frac{F}{PR} \text{ pence/long-ton n.ml.}$$

W (lb) is the weight of aircraft less fuel and payload.
V (kt) is the true mean cruise speed.
P (lb) is the payload carried.
R (n.ml.) is the equivalent still air range.
F (lb) is the fuel carried.

It will be seen that the second term (which is a measure of fuel consumption) has become relatively less important and this will tend to make the turboprop with its lower fuel consumption look less favoured. Applying the data of Mr. Robertson's Table 1 to the above formulæ, Table 2 is obtained:—

TABLE 2

Aircraft	Direct operating cost (pence/long-ton n.ml.)	
	Robertson	More realistic constants
Viscount 802	16.7	23.8
Britannia 300	13.0	18.9
Electra	12.8	18.1
Caravelle	16.5	20.2
Comet 4A	15.1	19.1
Convair 880	16.5	20.2
Boeing 707	15.2	19.4

HERE is a further contribution to the popular controversy about the relation between jet and turboprop operating costs. Referring particularly to Mr. Frank Robertson's recent examination of the subject, it comes from Mr. R. H. Whitby of B.E.A.

The Viscount 802 is designed for large seating capacity in relation to its weight payload, and in any comparison on a ton-mile basis it will appear at a disadvantage, so that it will be fairer (and will incidentally favour Mr. Robertson's point of view) if in taking average values it is not included.

TABLE 3

Aircraft	Direct operating cost (pence/long-ton n.ml.)	
	Robertson	More realistic constants
Average of turboprops	12.9	18.5
Average of turbojets	15.8	19.7
Turbojet dearer than turboprop by ...	23%	6%

The cost difference is then quite well in line with the more laboriously worked out data of Lord Douglas' Brancker Memorial Lecture—a tribute to the usefulness of Mr. Robertson's quick formula, provided more realistic constants are used!

Turning now to the hypothetical turbojet and turboprops of Mr. Robertson's article these are most easily considered by comparing the parameters $\frac{W}{VP}$ and $\frac{F}{PR}$ for these aircraft with current design practice. The first parameter is a measure of the lightness of the aircraft for a given "traffic delivery rate," while the second is a measure of the engine efficiency.

TABLE 4

	$\frac{W}{VP}$	$\frac{F}{PR}$
Turbojet		
Average for turbojets of Table 2...	0.0069	0.00089
"Bristvikjet"	0.0057	0.00095
Improvement assumed	17%	—7%
Turboprop		
Average for turboprops of Table 2	0.0081	0.00047
"Turbeuroprop"	0.0059	0.00038
Improvement assumed	27%	18%

Weighting the separate improvements by applying them to the cost formula, overall Mr. Robertson has allowed an improvement above present design practice of about 3 per cent for the turbojet. On the other hand for the turboprop about 25 per cent has been allowed. It would be interesting to hear what developments he has in mind which would give this. Is it solely low-consumption turbines (which can benefit the turbojet as well) and large propeller diameter?

Il-14 OPERATING COSTS

THE Indian Airlines Corporation (writes a correspondent in Bombay) recently sought from Russia details of the economics of the Il-14. The airline has been examining the relative merits of this aircraft and the Fokker Friendship, and [as related recently] it now seems certain that the Friendship will be chosen.

The Russian team which went to India gave some data—the first to come to hand—about the economics of Russian civil aircraft. The operating cost, says our correspondent, was the equivalent of £75 per hour as against £35 per hour for the DC-3. This was later revised to £67 an hour because the Russians had estimated the cost of overhaul to cover nine instead of one aircraft. The Soviet report showed that the Il-14 airframe life was 1,000 hours [presumably this was the major overhaul check period] and that engine life was 2,000 hours, "with intermediate overhaul every 300 and 500 hours." The first cost of six Ilyushins was £1.35m—i.e., £225,000 each.

Mr. Shankar Prasada, chairman of Indian Airlines, apparently suggested a scheme whereby his company would buy two Ilyushins on an experimental basis, on condition that they would be returned after a year if they did not come up to the original expectations. The Russians insisted on outright purchase, and the negotiations fell through.

IMPACT OF THE HEAVY JETS

THE I.C.A.O. "airport symposium" which opened at Montreal on March 19 was the first really well documented attempt by governments to get down to the airports and ground-aids problems. The sense of urgency was vividly provided by an American delegate who reminded the meeting that there were only 380 working days left before the Boeing 707 appeared on the routes.

The meeting is likely to result in action because it was the climax of a great deal of detailed work by individual governments and civil aviation organizations. Typical of these were the recommendations made by the representative of the International Federation of the Air Line Pilots Associations. Pertinent extracts from his recommendations (which were only *one* delegate's estimates of the subject), which provide some measure of the problem as a whole, are as follows: (1) nearly half the total number of turbine engine failures experienced by the U.S.A.F. have been due to the ingestion of dirt on runways—often causing subsequent engine failure *en route* (see page 457, "Blowaway Jet"); (2) one type of jet changes its take-off requirements by about 100ft for every 1 deg C increase in temperature; (3) runway widths as a result of U.S.A.F. experience might need to be of the order of 300ft as against the 200ft currently specified by I.C.A.O., owing to the inferior cross-wind characteristics of swept wing aircraft; (4) landing distance may well be the critical factor in determining runway length.

The following basic data for turboprop, subsonic jet and supersonic jet transports were presented by another delegate to the I.C.A.O. symposium.

	Supersonic	Subsonic	Turboprop
Speed	860-920 m.p.h.	500 m.p.h.	460 m.p.h.
No. of passengers ...	100	160	160
D.O.C./seat-mile ...	4 cents	2 cents	1.3 cents
Runway length ...	12,000 ft	9,000 ft	7,500 ft

THE VOICE OF HELICOPTER EXPERIENCE

ANY remarks about the future of helicopter operations by Mr. Robert Cummings, president of New York Airways, are worthy of record. His company is undoubtedly the most experienced commercial rotary-wing operator in the business, and its activities are of particular interest to the British industry in view of Mr. Cummings' past comments on the promise of British developments in this field.

Now, in an address in New York, he has disclosed that in the five months N.Y.A. had been operating S-58s, more hours have been accumulated on three machines than have been built up in military service on any one aeroplane of the same type in 30 months of operation. The airline is operating these aircraft and a fleet of S-55s (as described in previous issues) on a "catch-as-catch-can" bus technique, and the resultant technical and commercial experience well qualifies N.Y.A. for specifying future requirements.

"Our minds are wide open as to where we go equipment-wise," said Mr. Cummings, adding that he was in very close contact not only with the American manufacturers but also with the French and British. He repeated the requirements for two distinct types of machine, each with multiple turbine engines. The first would be for short-haul work with 20-25 passengers and a D.O.C. of not more than 10 cents per seat mile. The other type would have a 50-passenger capacity for the longer ranges, with a D.O.C. of not more than 5 cents per seat mile. "In England," he said, "specifically at Bristol and Fairey, great concentration has been given to meeting commercial requirements in addition to a machine which will be entirely useful militarily . . . There is basically no real difference between the two. The desired vehicle is an economic transport vehicle."

Comments about the future of helicopter operations were also made recently by Lord Douglas, chairman of B.E.A. Twin engines, he said, were essential, and the Bristol 192C (two Napier Gazelles) was "likely to be among the first proven twin-engined helicopters available." At the same time, B.E.A. were continuing to follow closely the Westminster and the Fairey Rotodyne. All these helicopters promised realization of B.E.A.'s ultimate objective—economically self-supporting scheduled services direct between city centres. "Such operations," said Lord Douglas, "will, we hope, follow on as a natural progression from the experience gained with the Bristol 192Cs." In the meantime, he added, B.E.A.'s activities were to be limited mainly to experimental and development flying.

BREVITIES

PRINCE Axel of Denmark opened the new six-storey S.A.S. House in Conduit Street, London, on March 25.

* *

K.L.M.'s profit in 1956 was £2,161,654, of which total £1,268,797 was appropriated for reserves. The net dividend will be 7 per cent.

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Chicago Helicopter Airways are to inaugurate on April 1 passenger services from O'Hare and Midway airports to downtown Chicago.

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The office of the Air Research Bureau has moved to 67 Rue de la Loi, Brussels: telephone numbers remain as 12.82.79 and 12.82.83.

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Sometime between the evening of March 5 and the morning of March 6 last, say I.A.T.A., the two-millionth tourist passenger crossed the North Atlantic. Tourist services began in May 1952.

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Liverpool Corporation last week "agreed in principle" to assuming control of Speke Airport from the M.T.C.A. Exploratory negotiations will begin with the Ministry and the operators concerned.

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President Eisenhower has ordered the U.S. delegation discussing traffic rights for K.L.M. in the United States (see last week's issue) to give the Dutch demands "the most serious consideration."

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A new text book on civil aviation, written by Dr. H. A. Wassenbergh, has been published by Martinus Nijhoff of The Hague. In English, and entitled *Post-War International Civil Aviation Policy and the Law of the Air*, it discusses the political and commercial structure of international air transport, how it has been built up since the war, and the law of the air. We hope to review the book in more detail in a later issue.

On April 1 Derby Aviation opened four-times-weekly DC-3 services between Derby and Glasgow. Seen here before departing on a pre-inaugural flight are (from left to right) the Mayors of Burton-on-Trent, Derby, Nottingham and Leicester—and their ladies. The service will enable passengers to leave Derby after breakfast and to be back for dinner after a working day in Glasgow.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Wyvern strike aircraft of No. 813 (F.A.A.) Sqn. make an aggressive above-cloud pattern. The squadron is operating from R.N.A.S. Ford, Sussex.

"Flight" photograph

Apprentices' Month

FIVE passing-out parades are being held this month at R.A.F. stations in Technical Training Command for more than 700 R.A.F. apprentices and boy entrants who have completed their training and will become fully qualified regular airmen.

The first takes place next Wednesday, April 10, at No. 2 School of Technical Training, R.A.F. Cosford, Salop, when the reviewing officer will be A.V-M. L. Dalton-Morris, A.O.C. No. 90 (Signals) Group. On the following day Air Marshal Sir Andrew McKee, A.O.C-in-C. Transport Command, will review boy entrants passing out from No. 4 School of Technical Training, R.A.F. St. Athan, Glam.

At the Administrative Apprentices Training School, R.A.F. Hereford, on April 13 the reviewing officer will be A.V-M. G. B. Beardsworth, A.O.C. No. 24 Group, Technical Training Command; Air Marshal Sir Geoffrey Tuttie, Deputy Chief of the Air Staff, will review aircraft apprentices graduating from No. 1 Radio School, R.A.F. Locking, Som., on April 16; and on April 17, at No. 1 School of Technical Training, R.A.F. Halton, Bucks, the reviewing officer will be Air Marshal Sir Douglas MacFadyen, A.O.C-in-C. Home Command.

Malayan Gift to 848 Sqn.

AN inscribed silver *kris*, traditional weapon and now a national symbol of Malaya, has been given by the Chief Minister (Tunku Abdul Rahman) and the Government of the Federation to No. 848 (F.A.A.) Sqn. for its three years' outstanding anti-Communist operations. The *kris* has been brought to Britain by the Flag Officer, Malayan Area, Rear Admiral G. A. Thring, who will present it to the former commanding officer of the squadron, Lt-Cdr. D. T. J. Stanley, at R.N.A.S. Lee-on-Solent next Monday, April 8.

Since it became operational in Malaya in January, 1953, the squadron, equipped with Westland Whirlwinds, has been involved in lifting thousands of troops into and out of the jungle, transporting V.I.P.s, tractors, tracker dogs, explosives and stores, and dropping leaflets. Two years ago, No. 848 Sqn. was awarded the Boyd Trophy for the most outstanding feat of Naval aviation in 1953.

Dome of Detection

A NEW type of rigid radome, intended for use by the R.C.A.F. on the Mid-Canada Line, has been developed by the Canadian National Research Council in conjunction with specialists from the R.C.A.F. and the U.S.A.F. This type of radome (one of which is depicted herewith) is of stressed-skin construction and does not require pressurization to retain rigidity. The present inflated type, made of fibre-glass or nylon fabric impregnated with neoprene, is subject to deflation if torn during storms.

One of the Canadian rigid radomes (described in the accompanying paragraph) built to house early-warning equipment.

These radomes house rotating radar equipment. The first rigid type was developed in the U.S.A. and after successful tests many are in use on the DEW Line and other radar chains.

R.C.A.F. Anniversary

IN celebration of the 33rd anniversary of of the R.C.A.F., the Air Force officers of the Canadian Joint Staff in London are to be hosts this evening (April 5) to members of the Commonwealth Air Forces based in England at a dinner held in the R.A.F. Club, Piccadilly, London, W.1.

Ration Increases

IMPROVED Service ration scales at home and overseas, starting this month, were announced by the Minister of Defence, Mr. Duncan Sandys, in a written Parliamentary answer on March 27. The most important change will be an increase in the meat ration; and the rates of allowances for those not drawing rations are to be raised, to take account of the new scales.

R.A.F.A. Report

IN a foreword to the R.A.F. Association's annual report Air Marshal Sir Robert H. M. S. Saundby, chairman of the national council, says that during 1956 the Association had been "able to do much to further its main object—to help in every way possible all men and women who are serving or who have served in the Royal Air Force, and their dependants." Sums collected on "Wings Day" had increased every year, the figure for 1956 exceeding that for 1955 by over £5,000.

The report, which is to be presented at the R.A.F.A. annual conference in Torquay on June 1-2, says that 1,646 pension cases were dealt with during 1956 at national and area headquarters.

IN BRIEF

The oldest maintenance unit in the R.A.F., No. 2 M.U. (Altrincham), was closed down for economy reasons on March 15.

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A Royal Air Force contingent is participating in the Franco-British Military Festival being held at the Palais des Sports in Paris from April 5 to April 14.

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Of the first 100 new-style aircrew battledress manufactured for the R.A.F., half are going to Fighter Command and half to Bomber Command for evaluation under service conditions.

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Over 3,000 schoolboys—members of the R.A.F. section of the Combined Cadet Force and school squadrons of the A.T.C.—are attending camps on R.A.F. stations during their Easter holidays.

Pilots of No. 257 (Burma) Sqn. after they had taken part in a fly-past in their Hunter F.6s on Friday, March 29, to mark the squadron's disbandment. The ceremony—at R.A.F. Wattisham, Suffolk—was attended by two attachés from the Burmese Embassy, Col. T. Han and S/L. K. Zaw, and the A.O.C. No. 11 Group, A.V-M. V. S. Bowling, inspected the squadron and took the salute at a march-past.